Editorial

BY the time this issue is on sale, it is possible that the Government will have made some announcement about its immediate plans for television in Australia.

To help it make up its mind, there has been, of late, a large amount said and written about the matter one way and another—some of it pertinent, some of it misleading, and some of it rather unfair.

Most people agree that it would be nice to have television if the programs are good, and we can afford it. The question is whether these two conditions can be satisfied now.

We must look at television against the domestic and world scene, because of its considerable impact on our financial and material resources.

The Postmaster General in various statements has covered the ground pretty well. To the recent Convention of Commercial stations he said that defence requirements must come before television. He stated, "We have other urgent obligations and cannot go too far too quickly." In Parliament he has explained the delay in vital communication projects as being due to shortage of skilled men and materials.

Television will, if launched on a full scale, absorb big quantities of these materials, including large numbers of valves and radio components which are scarce now, and will certainly be more so unless big additions are made to our manufacturing resources. We will have to import more of them, almost certainly including the picture tubes.

Several large radio manufacturers have told us that good television sets will cost about £200 here, including the sales tax. If adequate numbers of sets are to be sold, they must be carried on terms. But the Government's policy is opposed to time payments as illustrated by recent credit restrictions. Even cheaper sets are not likely to be bought on a cash basis in most cases.

Mr. Anthony has said that we must not prejudice defence for television, no doubt remembering that it will mean sinking big sums into administration and entertainment as well as manufacture and research. Against this, many consider that television is an essential part of defence, arguing that men trained in television are vital for designing and making radar.

In fact, however, modern radar and television do not overlap today as much as in 1941. Frequencies are much higher—many radar techniques and circuits are now part of every radio engineer's background. Moreover our defence problems are immediate. It would be years before television personnel would be sufficient to justify television as a manpower pool. Television's first demands would be on our present inadequate supply of trained men.

Obviously, any extension of our radio industry would be of great value in national emergency. But we should not strain this fact too far in imagining that television is the only way we could do this.

If we separate our immediate and long-term interests in the matter, it would seem therefore that, except on an experimental basis, television might easily demand at present too heavy a financial, technical and material price. USA for similar reasons has suspended development in color, and the BBC has curtailed its program of expansion.

In Australia, the Government cannot be blamed for hesitating before taking the risk.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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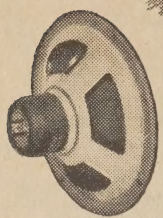
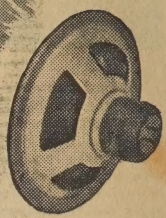
OUR COVER PICTURE

Walt Disney, master of the cinema cartoon, likes nothing better than to make his own fun with a super model railway. We see him here with Lily Belle, all set for a run around his own private track. (Story page 4.)

ROLA ANNOUNCES EFFICIENT NEW C.B. SPEAKER

Six-inch Model First of a New Range





To incorporate in its range of domestic loudspeakers a new and very efficient centre block magnet system developed by its engineers Rola Company (Aust.) Pty. Ltd. has embarked on a sweeping retooling programme.

Such re-tooling is an immense job, one which could only be carried out in a big and modern plant like Rola's. It will take time to complete but Model 6H, the first of this new "*Fluxmaster*" series of Rola loudspeakers, is now coming off the production lines and other new models will follow soon.

The centre block principle is not new — such units have been used in loudspeakers for years but, in general, have been inefficient because they have not made full use of the energy content of the magnet.

To appreciate this point, glance at Figs. 1A and 1B which show two typical centre block speaker magnet constructions. One uses a straight cylindrical magnet only and the other a cylindrical magnet topped with a "stepped"

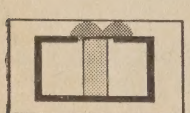


FIG. 1.A.

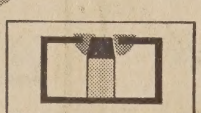


FIG. 1.B

pole piece the diameter of which decreases in the air gap.

To ensure that maximum energy will be developed across the air gap it is essential that the magnetic circuit be designed so as to keep leakage to a minimum. This is not possible in the designs illustrated in Figs. 1A and 1B.

The Anisotropic type of magnet used in modern loudspeakers has optimum magnetic properties along one axis. In the magnet assembly of Fig. 1A the magnetic lines of force are asked to turn, in the air gap, at right angles to this preferred direction and so losses are introduced.

This fault is overcome in the assembly shown in Fig. 1B by placing a mild steel pole tip on top of the magnet. This pole tip collects the flux from the magnet and leads a portion of it across the air gap. However, because of the size and shape of the pole tip large leakages take place.

Rola's solution to this problem was to place a thin

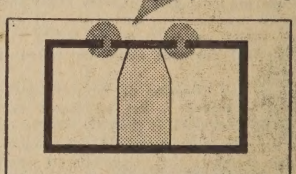


FIG. 2.

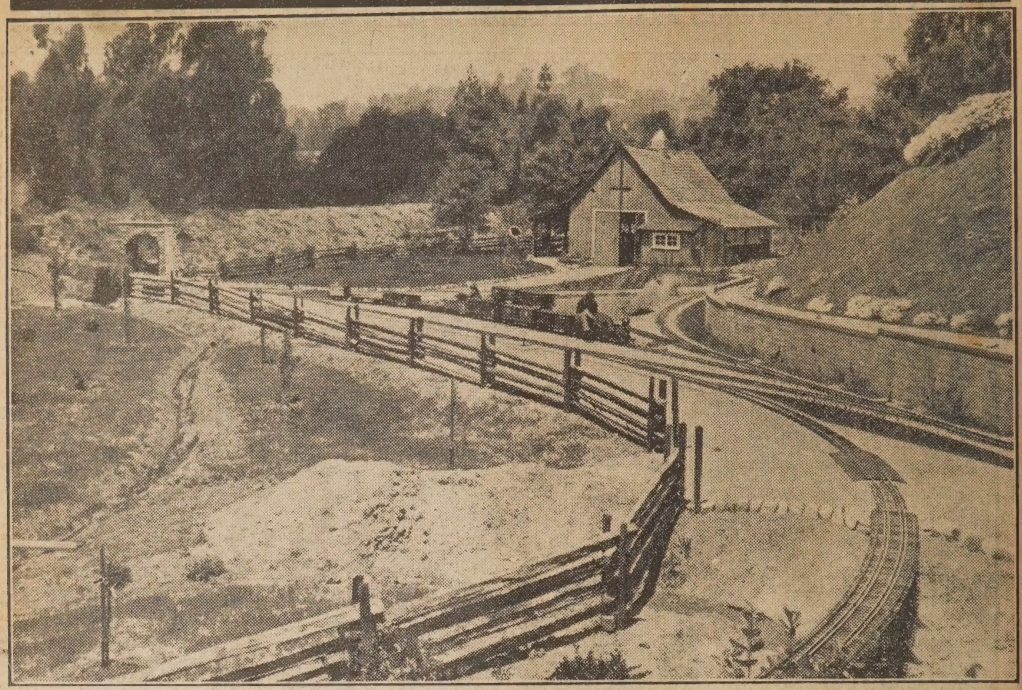
steel "collector" on top of the magnet. Its purpose is to gather the maximum magnetic flux and to concentrate it in the air gap—the place in which it will do most good. (See Fig. 2). This ingenious magnetic circuit was first introduced in the famous Model 12-0 and its even more illustrious cousin Model 12-0x. Its use in the 5, 6 and 8 inch models of the new "*Fluxmaster*" series will mean that these smaller speakers, too, will have many of the characteristics which made Models 12-0 and 12-0x famous as examples of outstanding loudspeaker engineering.

RADIO & HOBBIES

WORLD'S LARGEST RADIO TELESCOPE

This aerial, adapted from a wartime radar equipment is used in conjunction with the large equipment described on page 9 for detecting radiation from the stars. Main use of this aerial is to study the "twinkling" (in a radio sense) of the stars, thus throwing light on the movement of wind currents in the upper air.

DISNEY BUILT AND OPERATES



The engine Lily Belle passes the Red Barn, which houses a control booth and workshop.

Accident! The engine jumps the track at a switch, indicating that levelling is required.

There are plenty of enthusiastic model railway fans in Australia, but not many are able to contemplate a track like this one. It is owned by Walt Disney, who has probably brought more wide-eyed fun to the world's children than any other man.

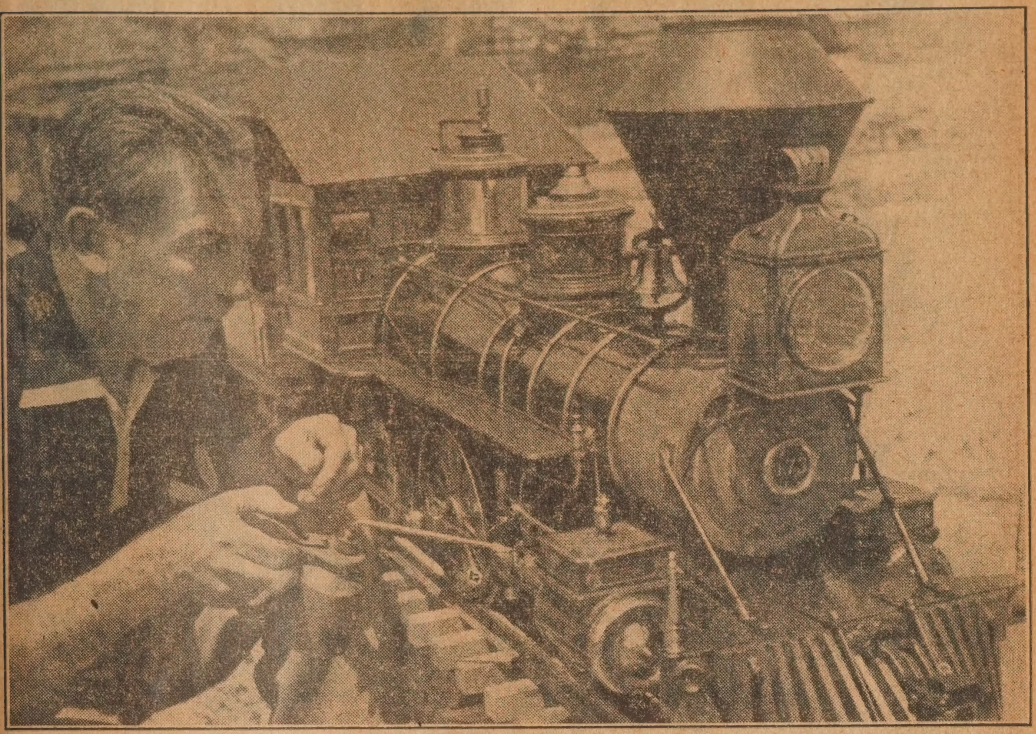
IT was inevitable that a man like Disney should have harbored a yen for mechanical toys. His work on cartoons and fairy tales would be impossible without the aid of many ingenious devices, all of which require correlation in someone's brain.

Disney's success has always been in the uncanny ability to tie reality to the actions of the toys and near-tops. He has mastered the sudden appearance of the outlandish gadget which enables a dog to use its tail as an airscrew, or Donald Duck to produce some mechanical marvel not at all out of place in this land of the cartoon—probably the purest form of all film entertainment.

This model railway which he has installed in his grounds is scaled 1-8th actual size, and runs on a track which duplicates real-life rail conditions. Much of the work is his own, although he has a small team of helpers, inevitable on such a project.

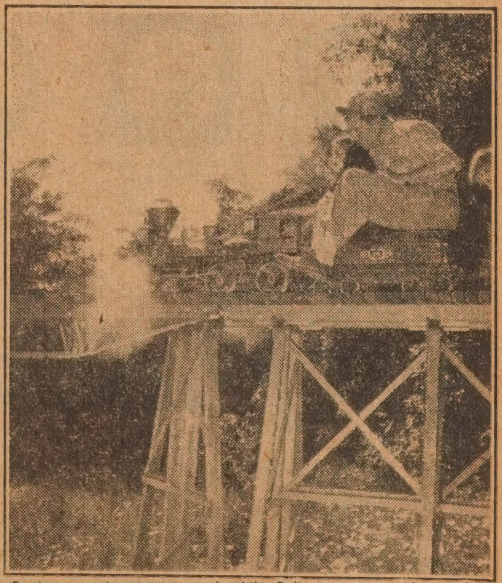
Many film celebrities have made rides on his railroad. He finds that although children tire of it, grown-ups rarely do.

SUPER SCALE MODEL RAILWAY



The engine is beautifully made. Here we see Disney at work with the oil can.

Bowling along at six mph with a juvenile load.



Engineer and passenger take Lily Belle across a 60ft trestle. Engine weighs 250lb.

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BRITAIN'S NEW TELEVISION MAST

Latest addition to the television stations operated by the BBC in England is at Holme Moss, from which services commenced on October 12, 1951. The opening of this station will greatly extend the television audience served.

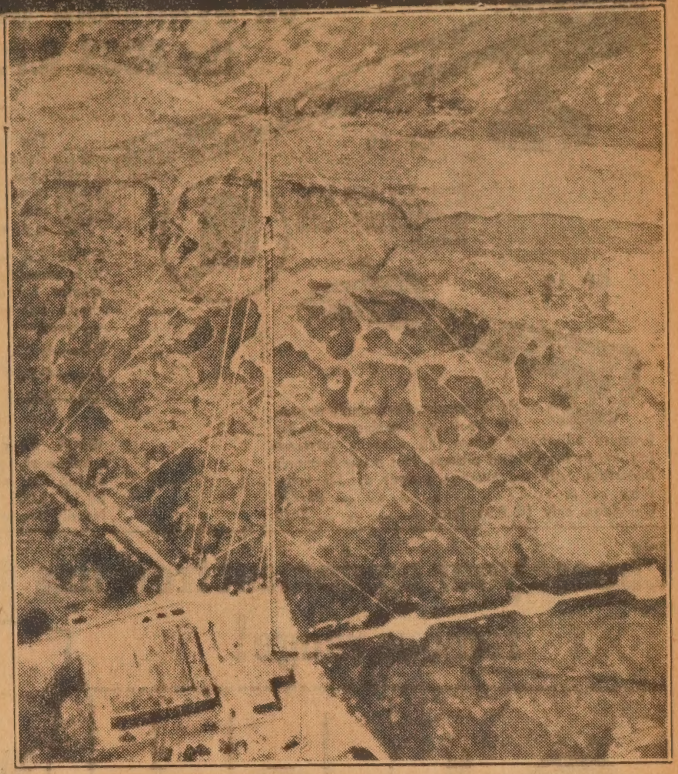
THE aerial mast is almost exactly the same as the 750ft structure at Sutton Coldfield, which houses the most powerful television transmitter in the world.

The mast supports eight aerials in all, some of which are used for communication links, and others intended for future use in connection with VHF broadcasting. Each aerial weighs about 500lb.

The mast is bolted together with 15,000 steel bolts, requiring a five-man crew to pull tight when the structure was finally erected. The mast itself weighs 100 tons, and is supported on insulators at the bottom. There is also an auxiliary mast 150ft high for use in emergencies.

It is estimated that Holme Moss will supply programs to an area where there are 11,000,000 prospective viewers.

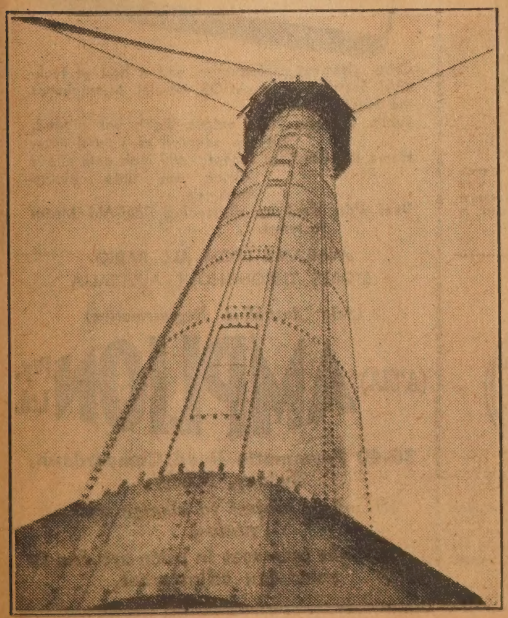
Several further similar stations are scheduled for erection in the BBC plan to cover the British Isles with television programs.

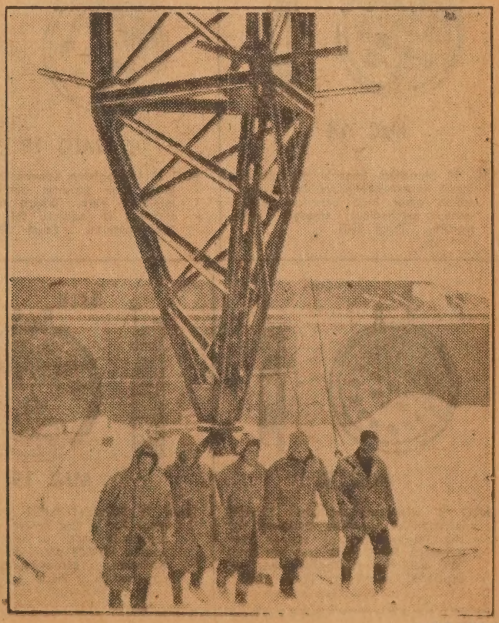


Top right: Aerial view of the completed mast.

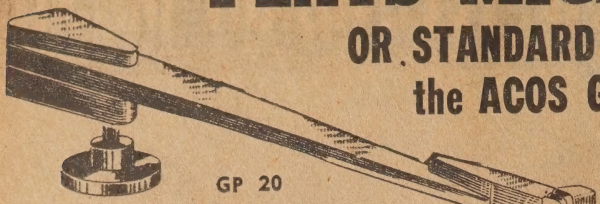
Bottom right: The base of the mast in winter snow.

Below: The cylindrical slot aerial from its base.





PLAYS MICROGROOVE
OR STANDARD RECORDINGS
the ACOS G.P.20 Microcell Pickup



GP 20

Inset: The Long Playing Head (GP-19LP) interchangeable with the Standard Head (GP-19).

The G.P.20 pickup is designed for use with the standard 78 r.p.m. records or the 33 1/3 or 45 r.p.m. long-playing microgroove records. To meet these differing requirements, two interchangeable slide-on heads are available.

G.P.19 head supplied as standard.

G.P.19 L.P. head available for microgroove.

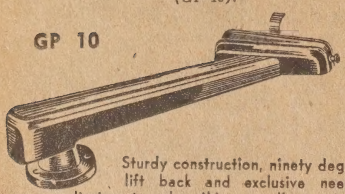
It is something new in pickup design and has 20 times greater output than comparable magnetic types, while needle talk and motor rumble are practically non-existent —permanent sapphire stylus—wide frequency response.

Price—G.P.20 complete with standard head £6/3/6

Price—G.P.19 L.P. head £3/11/0.

Price—G.P.19 standard head £3/11/0.

GP 10



Sturdy construction, ninety degree lift back and exclusive needle pressure adjustment makes this a really outstanding unit in the field of pickups. Has a low harmonic distortion, with an average output of 1.5 volts.
Price £3/2/9
Cartridge only (G.P.9) Price 36/9

G.P.11 Acos Pickup Cartridge incorporates permanent sapphire stylus. Replacement cartridge for ACOS G.P. 12 pickup and many American types. Useful frequency range 25 to 12,000 c.p.s.
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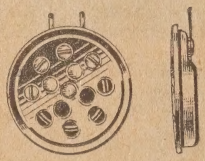
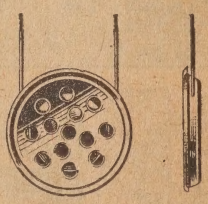


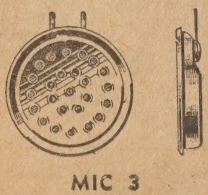
MIC 14

MIC 14 Standard Speech Microphone insert with nickel-plate brass case which gives high corosion resistance, mechanical strength and rigidity. Price 39/3.



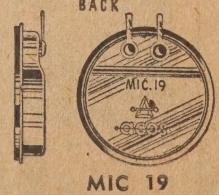
MIC 18

MIC 18 Microphone Speech Insert provides high acoustic qualities with minimum bulk. Where exceptional slimness is required this insert is recommended. Price 39/6.



MIC 3

MIC 3 Diaphragm-Actuated Crystal microphone specially designed for the reproduction of speech frequencies. With rising response from 1000 c/s, this microphone has exceptional sensitivity. Price 39/3.



MIC 19

MIC 19 Sintercel fulfils the requirement for a flat insert with good sensitivity and a frequency response 40/8000 c/s. Unaffected by vibration, exceptionally robust construction. Price £2/19/9.

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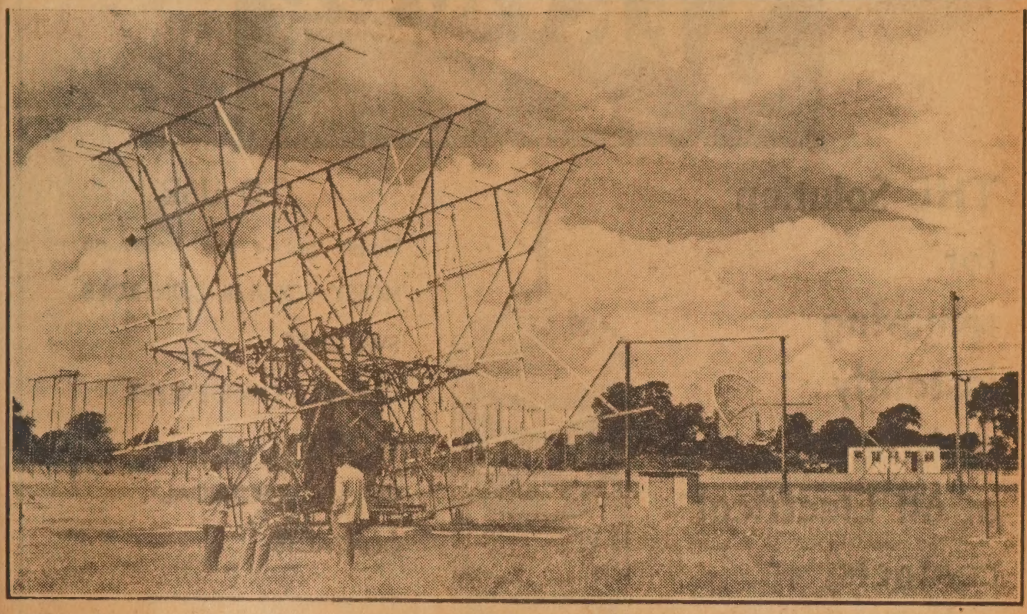
DARK STARS DETECTED BY RADIO



On the large control field at Jodrell Bank Experimental Station much of the equipment is reminiscent of wartime defence. In the background is the smaller radio telescope and on the extreme right the meteor radar aerials. In the foreground (left) is an ex-searchlight base which has been adopted for "looking" at the sky with radar.

Designed by Dr. J. A. Clegg, the largest radio-telescope in the world has been constructed by members of Manchester University Physical Laboratories at Jodrell Bank Experimental Station, in Cheshire

USING this telescope Mr. R. Hanbury Brown and Mr. Cyril Hazard have been able to detect and measure radio waves emanating from the great nebula in Andromeda, five million million million miles away from the earth.

As a result of their experiments they have found that radio waves which left the nebula 750,000 years ago, and have been travelling through space for more than the whole span of human existence, are being received on the earth. Although the power received from the most intense of these radio stars outside our own galaxy is measured in units of a million-million-million-millionth of a watt, it has been pos-

Inside the receiving hut, adjacent to the radio telescope, is the radar screen, where any signals from the Andromeda Nebula may be seen. Another radio receiving aerial is linked with an automatic camera which records radio activity from the stars in visual form.

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ble to devise equipment by which he signals can be both received and ecorded.

These radios stars do not coincide vith any of the bright visual stars nd cannot therefore be looked at vith an ordinary telescope, how-ver powerful it may be. The com-aratively new science of radio-stronomy has opened up a com-letely new field of astronomical re-earch, many branches of which are eing studied at Jodrell Bank.

It includes, in addition to the study f radio stars both in our own alaxy and exterior to it, research n meteors, on shooting stars, and n radar reflections from the moon. Vork on radio stars in our own alaxy is also in progress at the avendish laboratories in Britain nd in Australia, and other British entres are studying radio astronomy n general, although the 220 feet adio telescope at Jodrell Bank is nique.

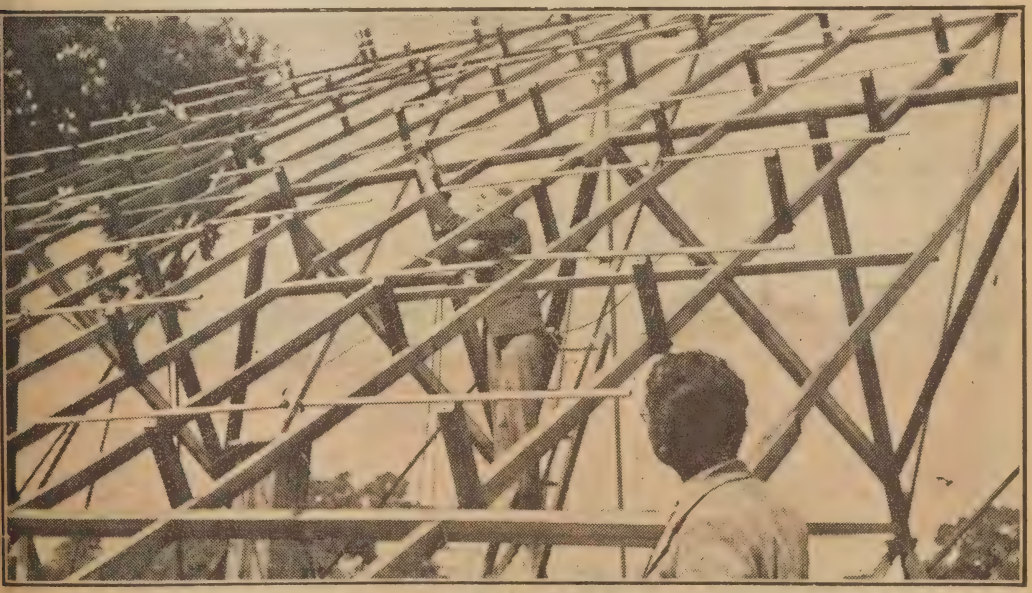
Manchester University has re-ently created a Chair in Radio stronomy, to be held by Dr. A.C.B. ovell, O.B.E., who has been director f the Experimental Station since its oundation.

AUSTRALIANS ACTIVE

In Australia, some of the earliest vork on "radio stars" was ca.ried ut by the Radiophysics Division of he CSIRO from an installation on he sea cliffs near Bondi. At this ocation was installed a star listen-ng post, the signals being picked p by an elaborate and specially uilt aerial system which could be et to follow the course of the stars, r to scan the sky in a predeter-nined manner.

This work is still being followed p, being only one of the projects n which the CSIRO is co-operating with overseas laboratories in re-search of all kinds. The correlation f results from various parts of the world has added greatly to the value f the work in general.

Members of the research team look up at the receiving aerial mounted on the 126ft mast, which is fitted to receive signals from the Andromeda Nebula, five million million million miles from the earth. They are standing at the edge of the saucer-shaped reflector made of fine wires in the form of a telescope mirror 220ft across.



One of the many aerials being built on the open sites at the Jodrell Bank Experimental Station, to be used for further study of the upper air. It is a high gain array of nearly 100 elements.

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- Meters of all types

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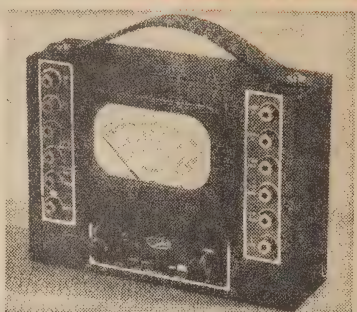
MODEL MK1 MULTIMETER KIT



This A.C./D.C. Multimeter Kit comes to you complete with everything right down to the last nut and bolt. It is carefully engineered and designed and all Resistors, Shunts, Meters, etc., are carefully pre-calibrated in the Factory to an accuracy of 1 per cent. Thus when you complete building this instrument there is no further calibration necessary. It has a wide range of A.C. and D.C. voltages up to 1000 volts and current can be measured in the following ranges:—

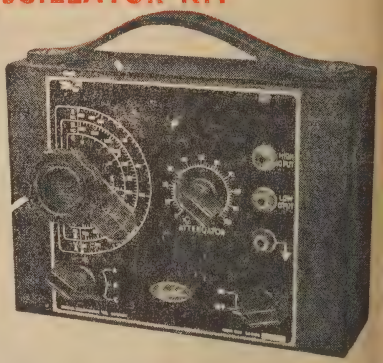
1, 10, 50 and 250 Milliamperes.

It is entirely self-contained for resistance readings which are up to 100,000 ohms.

It uses the popular 4" square type Meter with a clear Multi-Scale. All wiring instructions and constructional details are given with the Kit, and photographs and circuit diagrams make it simple. A completely illustrated well written Booklet of Instructions accompanies every Kit, and your guarantee of satisfaction is in the name "University." The size is 6" x 8" x 2½", and it's an exact physical replica in size to the Model OK1 Oscillator Kit, which is its companion.

MODEL OK1 OSCILLATOR KIT

For years of active service, yet simple to build at home with a few ordinary tools, Model OK1 Oscillator Kit covers all fundamental frequencies in the average receiver. It comes to you complete right down to the last nut and bolt and assembly can be done at home with a few simple tools. The Dial, Condenser, and Coil set-up is specially pre-calibrated at the Factory so that no further calibration is necessary when you complete building this instrument.



Standard Batteries are used and each OK1 Kit is complete with an Instruction Book which gives pictures and wiring diagrams of all parts and in addition gives full operating instructions for using the Oscillator to the best advantage when you have finished it.

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MOULDS THAT HAVE SAVED LIVES

Modern warfare, fortunately for mankind, is not wholly destructive. In wartime, thanks to the urgent need for munitions and the unlimited sums of money available, scientific research is speeded up and in consequence many discoveries, delayed in peacetime for lack of the necessary funds, are given every chance of quick development.

by Professor A. M. Low

NEW and more deadly weapons have been devised whereby man may destroy his fellow men, but at the same time new and more deadly weapons have been found to combat disease and to save thousands of lives. Indeed, given the opportunity, there seems no limit to the ingenuity of the human brain.

In almost every branch of medical science new drugs and new techniques have been found. Today a wounded soldier has three-and-a-half times as many chances of recovery as his counterpart in the first world war. The work carried out by British scientists in recent medical research stands second to none and should benefit the whole world.

PENICILLIN

Perhaps the most spectacular discovery made by British researchers that immediately springs to mind is that of penicillin, one of the many mould substances which are now being used in the service of man.

Certain of these materials are technically known as antibiotics. That is to say, they are organisms capable of inhibiting the growth of others. The mould *Penicillium notatum* wafted in through the window of an Oxford laboratory in 1929 and was observed by Professor Alexander Fleming. It is now giving us penicillin, a drug, by far the most potent germicide yet discovered, and is effecting cures at a speed which a few years ago would have seemed almost miraculous.

To many the word "mould" implies something decayed, something that is unhealthy. Spores of moulds are found everywhere in the air and, in fact, they do turn dead into living matter. From the air comes the green mould found on stale bread, the greyish patches that settle on improperly bottled jam, and the mould that causes dry rot in the wood of our homes.

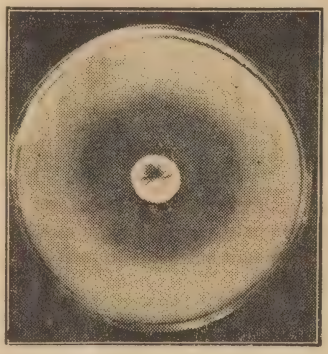
An example of the utilisation of moulds by man for his own ends is the case of Stilton and Gorgonzola cheese, where they are injected to produce the delicate green veining characteristic of these delicacies. These moulds are of the Penicillium species.

CITROMYCES

Thousands of moulds have been isolated and identified in British laboratories, but only a fraction of them have as yet been utilised. As scientific knowledge has advanced, however, moulds have been put to work more and more to assist required chemical changes, giving either new products or helping existing types to be made from new sources.

Moulds are extremely individualistic and there is considerable variation in the way they grow and the chemical changes they produce during the process of feeding.

For example, in the case of *Citromyces*, on one diet it produces citric acid but on another it produces oxalic acid. In the past the only source of citric acid was the juice of lemons, procurable only from Sicily and Italy, but the accidental discovery that a certain mould yielded citric acid when fed on sugar made the manufacture of this acid in large quantities a commercial possibility. Although it was some years before large-scale production was economically practicable, research went on and at length it was possible to regulate the life of the mould so that it produced citric acid instead of oxalic acid, or other more poisonous substances.



How penicillin kills. The grey outer ring on this culture dish shows live bacteria colonies. The clear inner halo shows bacteria killed by penicillin extracted from the mould in the centre of the dish. One part in 25,000,000 parts of water stops bacteria growth.

Moulds need certain specific conditions if they are to live and thrive. There must be correct temperature, humidity and oxygen. They are extremely prolific, but their work is done on the surface of the solutions owing to their need for oxygen, and one of the great difficulties has been to find a method whereby oxygen can be applied to the whole mass of a solution.

By the use of air under pressure this problem seems to have been solved and, in future, we may see factories where the workers are mould cells working a 24-hour day turning raw material into chemicals or food. Already in Britain bacteria are employed making useful gas from waste material and supply cheap lighting and heat to large cities.

We can see for ourselves how moulds and bacteria work in gardens and fields by breaking down organic material by the process of decay. They cause a series of chemical changes until the material is finally absorbed again by plants through the soil.

By the proper use of these moulds it should be possible to make use of this refuse much more quickly. There is no reason why huge piles of waste vegetable matter should not be employed at gas works and the inflammable gas they produce used for cooking and heating, or even for bottling under pressure to drive our motor-cars.

SUGAR FROM SAWDUST

There are other organisms which digest wood for certain insects. Already we can turn sawdust into sugar, and there is little doubt that we shall one day be able to turn the thousands of tons of sawdust from our lumber mills into a concentrated food for livestock. Just picture these mountains of sawdust and then think of this cheap raw material put to good use by the work of moulds.

Yeasts are substances closely allied to moulds and have long been used to bring about chemical reactions, such as breaking down the sugar into alcohol in beer.

Recently greater use has been made of yeasts in industrial chemistry. One of the latest yeast products is a yeast that lives on sugar cane and can be processed to give a rich protein food containing many of the essential vitamins or mineral salts lacking in some normal diets. In the West Indies Britain has set up factories for production of this yeast to supplement native diets lacking the necessary proteins.

Normally, vegetables are eaten by cattle and sheep and then turned into protein, which is taken in by human beings when they eat the animals. The waste involved by this process may be saved by this yeast, factory-produced. The further advantages of this short-circuiting method are likely to be very great in these post-war years.

Patulin, helvoic acid, penicillin and vivicillin are examples of other antibiotics developed by British scientists, and the names of Fleming, who

(Continued on Page 83)

This picture of Gladys Moncrieff as seen on a television tube during a Sydney demonstration is an example of fluorescence in a cathode ray tube.

FLUORESCENCE—MODERN LIGHT

The phenomena of fluorescence, discovered centuries ago, is winning a most important place in the technical, industrial and domestic world. In this article the history and some applications of fluorescence are related and described.

by Calvin Walters

THERE have been many tales about precious stones which adorned the temples of ancient people or the foreheads of their gods or their attractive female rulers.

The pupil of Aristotle named Theophrastus mentioned that the stone called a carbuncle glowed when exposed to the rays of the sun.

Pliny the elder some long time later said that a flame burned within the crystal of this stone.

What we call a carbuncle today is a sort of boil and it certainly seems, to those who have been afflicted with one, that a flame burns within it. However, this has nothing to do with our story.

A poet named Aelianus had some sort of a story which told of a grateful stork which, as a reward for a kind deed, dropped a luminous stone into the lap of a woman at Tarentum.

EARLY OBSERVATIONS

S. H. Ball, in an article in 1938, mentioned a story which he had unearthed. This told of a certain Benvenuto Cellini, who saw, in a merchant's shop in Ragusa, a white sapphire which glowed so brightly that it illuminated a very dark room.

It is quite clear that the Sydney electric light companies have never heard of these things, otherwise efforts would have been made to distribute them among the populace in place of the more conventional light globes.

The ancient philosophers spoke of such things as the light from glow worms and from rotting wood, so that, right down through the ages, we have mention of these luminous objects.

No doubt, many of these tales were products of a fertile imagination and some were due to some kind of trickery, at which the priests in some of the ancient temples were quite adept.

Falling within the latter category is the glowing column of transparent emerald which Herodotus saw in a temple at Tyrus.

The first really authentic account of a luminous substance came from a humble bootmaker of Bologna named Vincencio Casciarola.

This versatile gentleman was a rather famous alchemist in his spare time and naturally set himself the task of converting anything of a likely nature into gold.

So, in the year around 1600, he found some weighty stones and carted them home to his "cyclotron," which consisted of the usual furnace and bellows.

The result of the "brew" was not gold, but the same stones with the added facility of being able to emit a reddish light in the gloom.

It would appear from present-day knowledge that what the bootmaker had done was to convert the stones of barium sulphate into barium sulphide by heating. The stones probably contained traces of bismuth or manganese, which accounted for the ability to glow.

It was not until about 100 years after that this was understood and the general term "phosphor" given to substances which glowed like this.

The word is taken from the Greek translation of "lucifer," meaning "light bearer."

Later observations showed beyond doubt that certain substances did not shine by means of any inherent capacity for self-illumination, but were able to store light and emit it for a considerable time after the exciting source had been removed.

It was not until the end of the 19th century, however, that Verneuil and Lenard showed that mineral phosphors were capable of luminescence only when they contained traces of impurities, such as manganese, copper, bismuth and so on.

The perfectly pure mineral sulphide, oxide, carbonate, &c., did not emit anything—except the sulphide, which emitted only a bad odor when heated.

Mix them, however, with a trace of the aforementioned impurity and they immediately became luminescent, with a color according to the character of the added impurity.

EXCITING AGENT

The actual mechanism of the phenomenon is even now but partly understood and constitutes one of the small mysteries of science.

Nevertheless considerable progress has been made in the adaptation of the phenomenon to various purposes of commerce.

It has been found that to produce luminescence the exciting agent need not be visible light but may be ultra violet light, cathode rays, x-rays or any other form of corpuscular radiation.

Thus the present term of luminescence includes all the phenomena which involves the absorption of energy by a substance and its subsequent re-emission in the form of visible light.

There are various kinds of luminescence, namely "chemiluminescence," caused by chemical reaction; "photoluminescence," caused by the absorption of electromagnetic rays; "cathodoluminescence," due to electron bombardment, and "triboluminescence," caused by mechanical strain or fracture.

When a substance is luminous dur-

ing excitation the luminousity is called "fluorescence." The luminousity which persists after the exciting cause has been removed is referred to as "phosphorescence or afterglow." To those interested in carrying out some experiments, it is possible to produce some interesting results.

For instance, if two parts of sulphur, one part of finely ground lime and a half part of starch is mixed with a trace of bismuth nitrate and the mixture heated to red heat in a crucible, a creamy-colored powder will result, which, upon cooling and exposure to sunlight, will glow with a violet light.

If lead acetate or nitrate is used instead of bismuth for the "activator" the luminescence will be yellowish green. Manganese will give orange and zinc will give green.

It is wise for the purposes of domestic bliss and harmony to melt this mixture in the open air, as the odor given off during the process is most obnoxious and penetrating.

LUMINOUS PAINT

This mixture produces calcium sulphide, which can be mixed with clear lacquer or suitable paint to make a luminous paint. Use from 5 to 10 pc of the powder in the paint. This paint must have no lead in it, otherwise the luminous effect will be destroyed. It is advisable, if using clear lacquer, to paint this over a white background, also lead free.

The manufacture of commercial luminous paint is a much more complicated matter, which requires great skill in the manufacture in order to get consistent results.

If the salt, sodium potassium tartrate, called Rochelle salt, is dissolved into a strong solution and boiled in the dark, it emits showers of violet blue sparks.

The phenomenon of triboluminescence can be observed by melting boric acid in a crucible and allowing it to cool down in a dark room. As the temperature falls the solidified acid will crack, emitting flashes of greenish light while doing so.

Chemiluminescence will be observed if sodium fluoride is dissolved into a saturated solution and allowed to crystallise in a darkened room. As each crystal forms it gives rise to a remarkable twinkling effect which is most brilliant. This effect has never been really explained.

The mineral mica will emit a glow if the sheet is peeled apart in a dark room.

NEON LAMP

The fields of application of the phenomenon of fluorescence is growing rapidly and new uses are being attempted in most famous laboratories.

Perhaps the most well-known application is the now common "neon lamp." This consists of a tube, the inside of which is coated with a suitable fluorescent material, such as manganese activated zinc silicate. Each end of the tube contains an electrode, and drops of mercury are inserted at intervals in the tube. When an electric current is passed through the tube by means of the electrodes, ultra violet light is produced, which in turn causes the material on the inside of the tube to become luminous.

The fluorescent screens used in x-ray examinations are a further example of this type.

A glass plate is coated with the fluorescent material, which must be very carefully prepared. It is obvious that the material used must not have any afterglow, as this would be detrimental to the observation of one's insides by the x-ray man.

The material mostly used is zinc cadium sulphide with the addition of a minute quantity of nickel. The nickel acts as a quencher of the afterglow without affecting the phosphorescence of the sulphide.

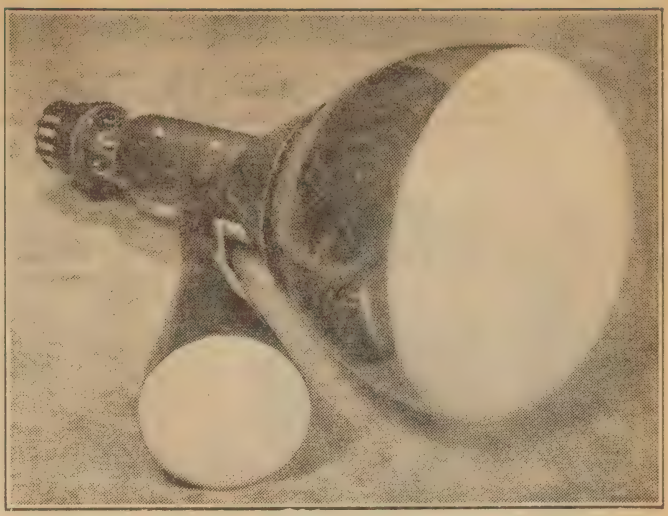
These screens are activated by x-rays. The fluorescent surface is protected by a varnish which is transparent to x-rays and the back of the screen is heavy lead glass which transmits the fluorescent light and at the same time prevents any x-rays not absorbed by the fluorescent screen from reaching the operator.

Other important applications of fluorescence lies in the screens used in oscillographs, television receivers and the electron microscope.

In these the fluorescent material is coated on the large end of the tube while at the other end is an element which emits cathode rays when heated. These rays are focused on to the fluorescent screen which glows according to the movement of the cathode rays.

The importance of using a fluorescent material which is not subject to afterglow can be appreciated here. Such a factor could be very upsetting to calculations made on the screen and particularly so to the image produced by television.

These tubes are also the vital part of radar equipment.



Two cathode-ray tubes showing the screens which glow when the internal electron beam strikes them.

USE IN ANALYSIS

In chemical analysis fluorescence is playing an important role.. It has been found that certain dyestuffs are strongly fluorescent under certain conditions.

For instance, in the field of bacteriology, certain bacteria can be dyed by these dyes and their movements easily followed under the microscope. This helps considerably in identification.

The ageing of rubber can be followed by changes in its fluorescence

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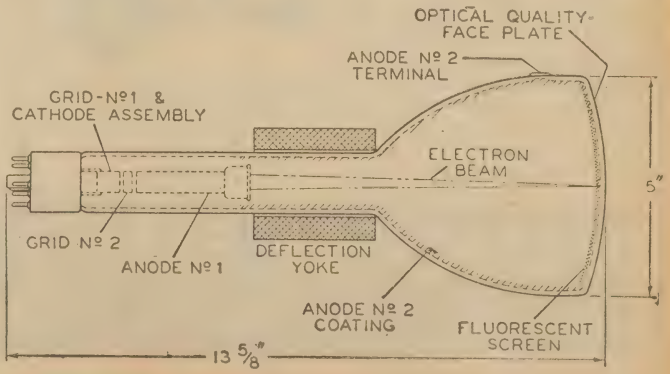

A special television cathode-ray tube showing how the picture is "painted" on the fluorescent screen by an electron beam.

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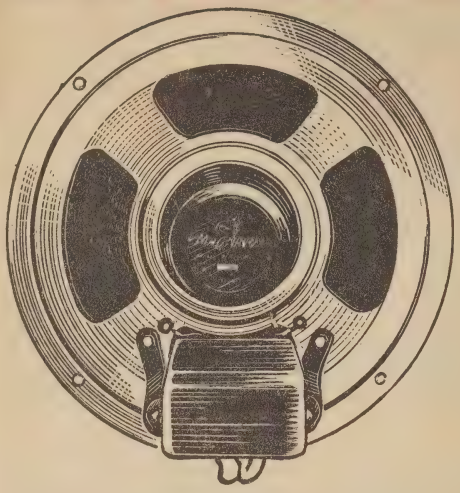

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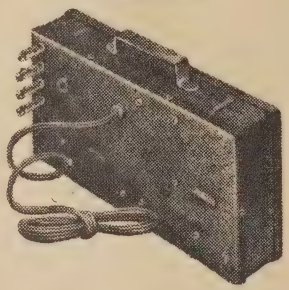

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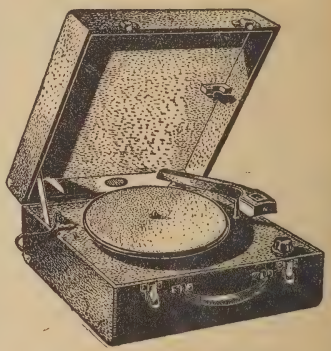

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Technical Review

"EXTENDED CLASS-A" AUDIO OUTPUT STAGE

A novel output stage, described before the Audio Engineering Society in New York, makes use of triodes and pentodes operating in parallel in the push-pull output stage. The resulting composite is claimed to exhibit the best features of both types of valve.

SUMMING the problems of audio amplifier design, the author of the paper, H. T. Sterling, points out that a class-A output stage exhibits notoriously low plate circuit efficiency, ranging from about 30 pc at full output to zero pc at no signal.

When reproducing ordinary music, the full power of the stage is required only occasionally on peaks. During most of the time it is drawing full plate current and delivering only a very small amount of power.

This can be a serious disadvantage in high-powered equipment, both from an economical standpoint and from heating due to total power dissipation.

OVERBIAS PROBLEMS

The result has been the widespread use of class AB or class B operation, wherein the output valves are substantially overbiased and draw full plate current only on signal peaks. There is an immediate saving both in the rating of the power supply equipment and the total heating in terms of input watts.

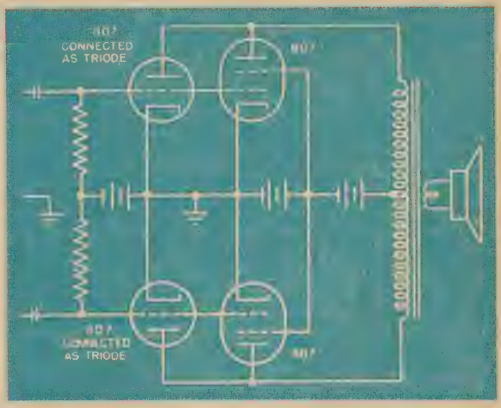
A disadvantage of overbiased operation, particularly class B or class AB2, is that a switching transient occurs as the plate current of either tube passes the cut-off point. The effect actually arises in the output transformer and does not appear in valve ratings. Unless the subject of special care, this "notch" distortion can be serious at frequencies above a few thousand cps.

IDEAL CONDITION

A desirable condition for high quality equipment would be the combination of class A and class AB characteristics, such that notching effects would be eliminated, yet the amplifier would have the ability to draw extra current and deliver extra power on peaks.

Extended class A operation confers this advantage. It involves connecting a triode in parallel with a tetrode in each leg of a push-pull circuit, as shown in figure 1. The valves must be suitably chosen to operate with a common bias.

The triode would normally be biased for class A operation, the tetrode screen voltage being set so that they are normally at cut-off. The tetrode is inactive during the whole of the negative half-cycle and only comes into operation when the signal potential reaches about one-third of its maximum positive swing.



Circuit diagram of the extended class A output stage using 807 tetrodes wired in parallel with 807 triodes. The circuit combines the good low-level qualities of class A triodes with the peak power capacity of tetrodes. Feedback may be applied in the ordinary way to improve still further the characteristics of the stage.

COMBINED EFFORT

Since both valves normally have the same bias, however, they both reach grid-current point at the same instant.

During this portion of the cycle, the steep plate current rise of the tetrode produces a large voltage swing, which reduces the instantaneous voltage on the triode plate to a low figure.

By adding together the instantaneous values of current for specific plate and grid voltages, it is possible to produce composite curves from which operating conditions can be accurately derived.

The stage acts as class A push-pull triodes at low levels of reproduction and, as a result, preserves good linearity and a favorable damping factor. Negative feedback can be applied in the usual way and operates effectively over the whole cycle, whereas there may be lapses in the feedback function of a class B amplifier during the instants when the output valves are both near cut-off.

If desired, the heaters of the tetrodes can even be switched off altogether when it is known that high power peaks will not be required. In any case, the tetrodes will give long life, because they conduct only at intervals.

When they do conduct, however, they may produce peak current demands rising as high as three times the quiescent drain of the amplifier.

TYPICAL VALUES

Typical operating conditions for parallel 807's, which work well as both triodes and tetrodes, apply 450 volts to the plates, 300 volts to the screens and minus 45 volts on the grids. The power output without grid current is 50 watts.

By providing a low impedance drive to both grids, as from a 6SN7 cathode follower, the grids may be driven slightly positive for a 20 pc increase in output power—amounting to 60 watts total ("Electronics").

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APPLICANTS with former commissioned service in His Majesty's Forces will be considered for appointment in his former rank or such rank as may be commensurate with his qualifications and experience. Other candidates will normally be offered the rank of Pilot Officer but higher rank may be determined depending upon qualifications, age, and other attributes. Officers are required to contribute to a pension scheme which provides a generous retiring allowance and covers invalidity or death during service.

For further information write to:—

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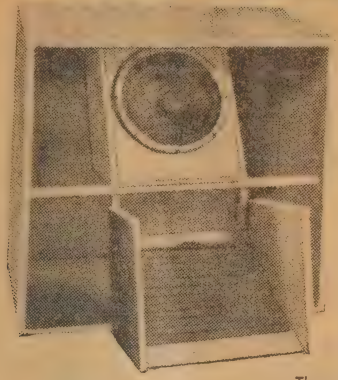
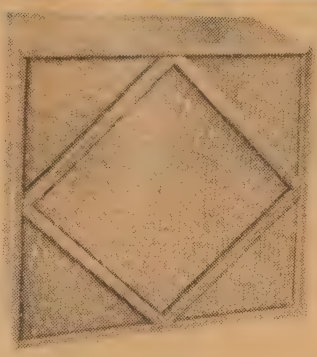
HOW TO BUILD A SMALL CUBICAL SPEAKER HORN





These pictures show the general appearance of the horn.

Loud speaker housing is quite important for good results, and many ingenious ways have been evolved to get the most from the average unit. This design, originally appearing in "Popular Mechanics" was produced by a Westinghouse engineer and has many attractive features.

By
Dr. Richard Hitchcock

THIS folded exponential horn, in a 20in cube, has remarkable range of frequency response. Previous exponential horns have pleased the music lover and high-fidelity enthusiast, but they were either too high for use in a living room or, if they were low enough, they lacked high-note response.

It is well known that high audio frequencies leave a speaker diaphragm as a narrow beam, and with earlier low speakers the beam was too low to reach the listener's ear.

A simply constructed acoustic prism solves this problem as shown in the accompanying diagrams. The speaker is inclined 30 deg., and the prism also bends the high notes 30 deg., so that you can hear the beam even if you are standing.

A good 8in PM speaker is small enough to reproduce the high notes of fine music, yet large enough to move air for the bass tones. The bass tones come from the back of the diaphragm, and the exponential horn carries them around so that they emerge from the front of the assmbly. Low tones bend readily as they have no beam effect.

Since no absorption is required, or desired, the efficiency is high, and 3/8in plywood is adequate for construction. All joints should be carefully glued and nailed. The 8in speaker should be an extended-range type with a power-handling ability of about 7 watts.

From the 8in driver, the horn reproduces low notes as well as 15in speakers. Further, the use of a single reproducer eliminates crossover networks and intermodulation distortion. This distortion is present in many two and three-element loud-speaker systems. It is prevented in this design because the horn loads the single diaphragm.

You will find that this speaker-horn combination sounds as loud with seven electrical watts input, as 28 watts to a speaker equipped with an infinite baffle (a tight box lined

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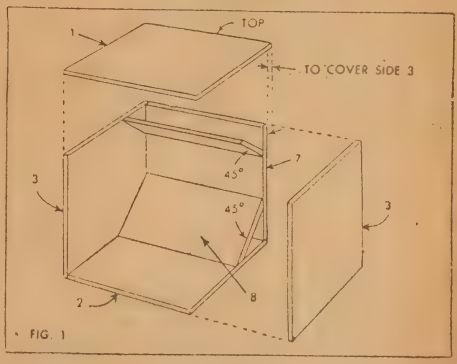

FIG. 1

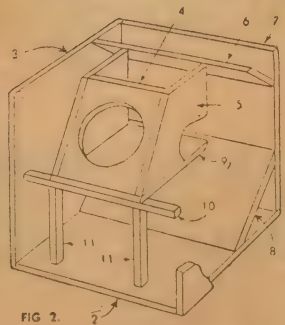

FIG 2.

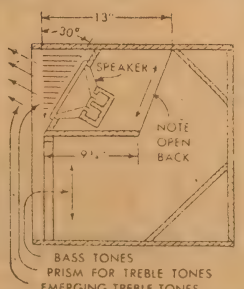

FIG 3. CROSS SECTION SHOWING PRISM

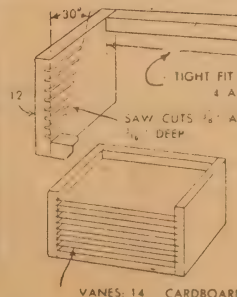

FIG 4. ACOUSTIC PRISM

Presenting the *Magic* of Microgroove

"Sound Quality" PRODUCTS

R33 PORTABLE DUAL SPEED MICROGROOVE RECORDER AND PLAYBACK UNIT

Where there's a three pin power socket —there's your recording studio. Completely self-contained microgroove disc recording unit with five functions:—

1. Record from Microphone.
2. Record from External Source (Radio Tuner).
3. Reproduce from External Source.
4. Reproduce from Recordings and Commercial Pressings.
5. Public Address System — Reproduce from Microphone.

T25 SUPER-SILENT DUAL SPEED TURNTABLE

. . . . . Developed primarily for the discriminating enthusiast, the T25 is the quality instrument of the playback field. No rumble . . . . . no flutter . . . . . no "wow" . . . . . just a continuous flow of smooth power for both microgroove and standard recordings.

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L. S. Wise & Co., 14 Pirie St., Adelaide. C818.

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Swan Electrical Co. Ltd., Wellington, Christchurch, Auckland, Dunedin.

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BYER INDUSTRIES PTY. LTD.

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BUILD A SMALL CUBICAL HORN

(Continued from Page 19)

with absorbent material). You gain an additional advantage as your amplifier has less distortion at lower power outputs, and less than seven watts will drive the horn so clearly that you will not have to turn up the gain on your amplifier.

Photos A, B and C show various views of the completed unit. The acoustic prism, which bends the high notes, is a series of parallel and horizontal sheets glued into the sidepieces, 3/8in apart.

These sheets can be heavy cardboard, plastic or metal. Figure 1 shows the first step in assembly with the right-hand side and top removed. The speaker panel, housing and braces are detailed in Figure 2. All dimensions can be easily checked in the material list. Figure 3 is a cross section through the middle, showing the prism.

Note that the back of the speaker housing is open to the horn. Figure 4 shows the acoustic prism, partly

MATERIAL LIST

Item	Reqd	Name	Dimensions inches
1	1	Top	20 x 20 x ½
2	1	Bottom	20 x 19½ x ½
3	2	Sides	20 x 19½ x ½
4	1	Speaker Panel	10½ x 8½ x ½: 30°, 30°
5	2	Sides, Speaker Housing	9 x 12 x ½ (See Fig. 3)
6	1	Slant Panel	8 x 19½ x ½: 45°, 45°
7	1	Back	19½ x 19½ x ½
8	1	Slant Panel	12 x 19½ x ½: 45°, 45°
9	1	Bottom Speaker Housing	9½ x 10 x ½
10	1	Brace	1 x 19½ x ½
11	2	Brace	1 x 9½ x ½
12	2	Prism Sides	7 x 9 x ½
13	2	Prism Braces	½ x ½ x 9½
14	17	Prism Vanes	Cut to fit prism sides (Item 12)

and fully assembled. The front grille detail is quite simple as will be noted in photo A. Either heavy grille cloth or brown flock-coated grille screening may be used. This grille screening is galvanised wire mesh, flocked on both sides. Another grille material now available is Lumite-plastic grille cloth. It requires no backing and is of the wide mesh basket-weave type.

Operating as an auxiliary speaker, this folded exponential horn can be used with any high-grade radio receiver or audio amplifier.

Above—This table gives dimensions of the wood sections required to build up the horn.

★

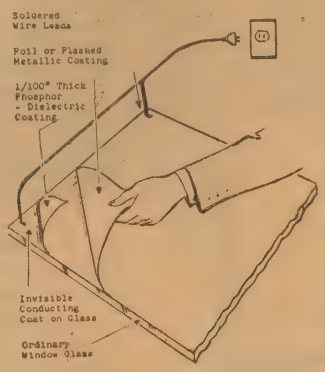
The finished job is decorative and not too large to place easily in the average room.

LIGHT BY ELECTROLUMINESCENT

A new principle of producing light—entirely different from either incandescent or fluorescent light—employing thin, flat sheets of glowing glass instead of bulbs or tubes, was demonstrated recently by Sylvania Electric Products, Inc., New York.

IT operates at extremely low cost on conventional household alternating current, and it is claimed that it will have an expected life of one to five years.

Sheets of this glowing material can be made in almost any size to provide luminous ceilings, walls, tables, clock faces, stair risers,


Soldered Wire Leads
Foil or Flashed Metallic Coating
1/100" Thick Phosphor - Dielectric Coating
Invisible Conducting Coat on Glass
Ordinary Window Glass

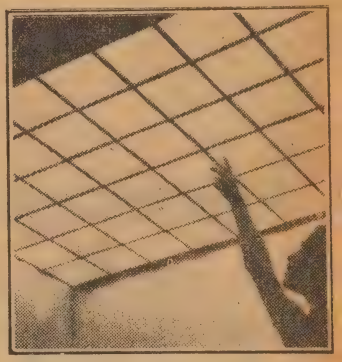
Diagrammatic sketch shows composition of electroluminescent sheet.

switch-plates, and signs. This "area" light source, said to be the goal of lighting engineers and architects for generations, is a luminous kind of condenser which Sylvania calls "Panelite." The technical term for this new lighting development is electroluminescence.

The new type of lamp consists of a special sheet of conductive glass, on which is placed a "phosphor-electric" coating, and a layer of vaporised aluminium. These two coatings add less than a hundredth of an inch to the glass itself, thereby achieving almost the ultimate in thinness. Wires are connected to the edges of the sheet to pick up current directly from 110-volt 60-cycle house current. Under this condition, the brightness of the sheets is said to be more than enough for night clocks.

ARCHITECTURAL APPLICATIONS

For greater brightness a small inexpensive transformer is introduced in the circuit to bring the voltage up to 400-500 volts. This transformer would be no larger than a cigarette package for a panel a foot or two square. The transformer multiplies the light output by twenty. It is



Luminous ceiling, only ¼in thick and 6ft wide, is an architectural use for the new area lighting source, known as panelite.

said to be ample for low-level illumination of restaurants, elevators, theatre aisles, and many other decorative and architectural applications.

ECONOMICAL

So economical is the current consumption of the new lighting method that many of the applications not requiring a transformer, such as wall-plate switches, clock faces, and safety lights, can be permanently connected to house or building wiring to run 24 hours a day. Most uses of this sort would be rated at about 1/25 of a watt. It would cost practically nothing per year to operate continuously. Even with the use of transformers, which build up brightness and therefore require more power, a 4ft by 6ft panel consumes less energy than a 25-watt light-bulb.

The panels will be made in a variety of colors, including white, a golden yellow, and a light blue. A brilliant green color is the only one commercially available at present.—(US Mechanical Engineering).

At last

A PRACTICAL XMAS GIFT FOR THE RADIO ENTHUSIAST

OR

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This Xmas, the ideal gift for the radio enthusiast is A.R.C.'s nine kit home practical Radio course. It is comprised of hundreds of interesting practical experiments, out of which can be built a professional test panel (see below) at only a fraction of the cost of separate factory-built instruments.

Into a series of nine kits, A.R.C. have packed all the components required for hundreds of interesting and instructive radio experiments. They provide the practical work so essential for the full understanding of radio. The kits are ingeniously planned so each builds on the last, expanding the range and complexity of the experiments.

Instruction books using hundreds of diagrams and illustrations as well as text explains fully every step involved. The student is led from the simplest tests to more and more complicated ones, until he has the knowledge and confidence to build all the components supplied into the fully professional test unit illustrated above. This unit, which can be set into a permanent service bench or mounted in a case as a portable tester, will form a vital part of any serviceman's equipment.

Housed in this handsome carrying case, you have an instrument of which any radio technician would be proud.

If you are keen to gain practical experience of radio, and pave the way for a profitable occupation, write for details of the A.R.C. Nine-Kit course of instruction. The coupon below will bring you a free illustrated brochure.

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RADIO ELECTRONICS WORKS FOR WEATHER MEN

Shifting regions of extremely hot gases in the atmosphere of the sun—as well as the well-known sunspots, actually cool areas—have pronounced effects on such terrestrial phenomena as magnetic storms, poor radio reception, and northern lights. There are being watched constantly by observatories all over the world in efforts to predict "solar weather," and, by this means, the earth's "radio weather."

By THOMAS R. HENRY

THIS is a particular job of the US Bureau of Standards. Sometimes it is necessary to follow 10 or 15 such active regions which may exist on the sun simultaneously. It is known that there is a tendency for the most active regions to be associated with radio disturbances, usually when the region is nearest the centre of the sun's disc.

For accurate forecasts, the sun must be kept under constant observation. This means that cloudy weather cannot be allowed to interfere. All observations must be made simultaneously.

There are relatively few solar observatories. Some are on mountain peaks, to take advantage of the thinner atmosphere. Others are near univerities with special interests in solar physics, but usually away from dust-filled city atmospheres. This dispersal permits the sun to be under continual observation, for while clouds may obscure the disc over one observatory, the sky usually is clear over another.

SUNSPOTS

Sunspot measurements, the easiest of all to make, are being reported regularly to the bureau of standards from two observatories in the United States and two in Europe. Observations are reported, almost as soon as they are completed, from the naval observatory at Washington and the Mount Wilson observatory in California.

In Germany, the Wendelstein Observatory, on a peak south of Munich, makes sunspot observations many hours before the sun rises in the United States. The results are transmitted to Washington immediately. Similar observations are reported from the Meudon Observatory, near Paris.

This would be fine if sunspots told the whole story. Unfortunately, the other necessary observations are harder to make, requiring special equipment. One job is that of finding and determining the brightness of concentrated clouds of calcium gas in the sun's atmosphere.

INNER CORONA

Most of this is done at the McMath-Hulbert Observatory, near Pontiac, Mich. The information is immediately telegraphed to Washington.

Another important type of solar activity is the intense radiation from the sun's inner corona—the inner part of the sun's outer atmosphere. The corona is the most difficult of all solar phenomena to observe. It is necessary to put observatories at high altitudes, where the sky is exceptionally free from dust and water vapor.

Five widely-separated observatories are engaged in this work. Still, there frequently are periods of days when reports cannot be obtained. Two observatories are in the United States—one at Climax, Colo., and the other on Sacramento Peak, near Alamagordo, NM. The Wendelstein Observatory in Germany is a major contributor, and so is another on an isolated mountaintop in the Pyrenees.

An air-launched automatic weather station which can be dropped from a plane into inaccessible enemy territory and provide complete weather information has been developed by the US bureau.

After the station has parachuted to earth, controlled explosive charges are used to disengage the parachute, raise the station to an upright operating position, and erect an antenna. Weather-responsive devices then cause resistance changes which switch a radio transmitter off and on at a rate which can be interpreted at a receiving station in terms of temperature, pressure, and humidity.

Designed in the shape of a bomb and packing its own parachute, the weather station is loaded on the bomb rack of a plane. When it is released over a desired location, the parachute is opened automatically by a line rigged from the plane. Simultaneously, an electric clock, which controls the subsequent operations of the station, is started.

The impact of landing sets off a small explosive charge which disengages the parachute, and prevents the station from being pulled along the ground. Either immediately, or after a period set before him, another explosive charge causes the station to rise to an upright position.

This is done through an arrangement of six legs to which springs are attached. The explosive charge operates a release, permitting the springs to pull the legs into position. A third explosive charge extends an antenna to a height of about 20ft.

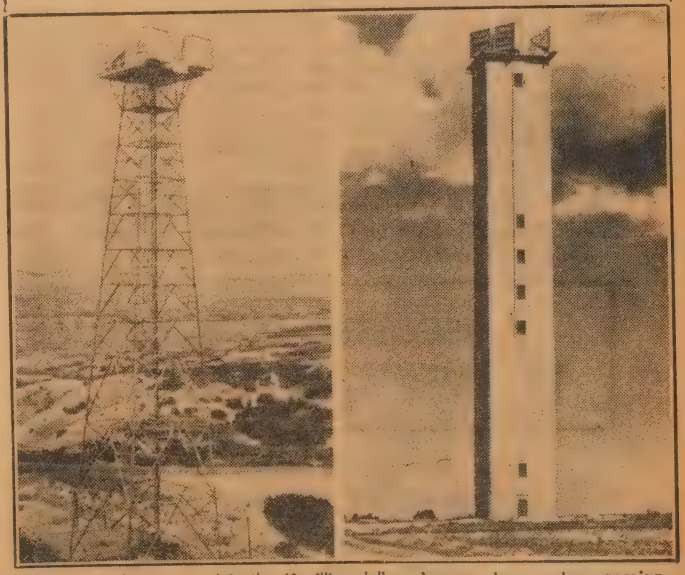
POSSIBLE USES

Such a station would be adapted to transmit various kinds of information out of enemy territory, but the present design permits only the transmission of weather data. Separate mechanisms responsive to changes in temperature, pressure and humidity each cause an associated resistor to vary.

At predetermined intervals, the timing mechanism turns on the radio transmitter. The transmitter is so designed that the emitted radio signal pulses off and on at a rate proportional to the resistance set up. The station is calibrated before use by subjecting it to known temperatures, pressures and humidities.

Such a station also may be used as a radio beacon for aircraft. In such a case, the transmitter and the control mechanisms are greatly simplified so that either a constant or intermittent signal is sent out.

AERIALS FOR MICRO-WAVE RELAYS



Two types of towers used in the 40-million dollar microwave beam system spanning the USA and which is now in operation. One hundred and seven towers, some of steel, some of concrete, carry the beam from New York to San Francisco. Tower at left is at Salt Lake City, one at right is between Chicago and Des Moines. The link also carries coast-to-coast television.

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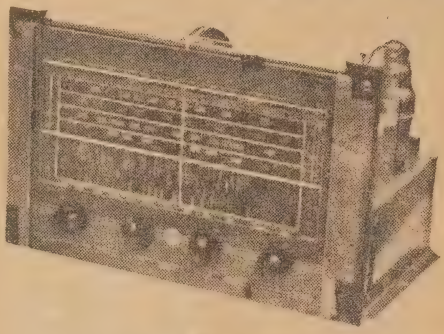

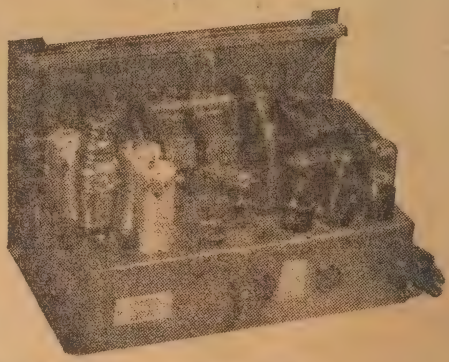

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- High gain audio with push-pull output and tone control gives you high fidelity reproduction from both radio and your favorite recordings.
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- All chassis are wired for the fitting of an F.M. or television tuner, special plug on back of chassis being provided.
- Speakers supplied are Magnavox 12" and 8" permanent magnet with tropic proof transformer. Single 12" supplied with 6 valve chassis.
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NEWS AND VIEWS OF THE MONTH

Distinguished Visitor

A DISTINGUISHED visitor just arrived in Australia is Dr. V. K. Zworykin, vice-president and Technical consultant David Sarnoff Research Centre RCA Laboratories Division of the American RCA.

During his three weeks' stay in Australia he will visit the Universities of Sydney, Melbourne and Adelaide where he will address Institutions of Physics, Engineering, Radio and Electrical Engineering in conjoint meetings.

Dr. Zworykin is one of the best known figures in the modern electronic world, famous for his work on the iconoscope which had such a wide influence in the development of modern television.

Engineers and physicists alike will look forward to meeting Dr. Zworykin for whom a warm welcome is assured.

★ ★ ★

Anniversary

CONGRATULATIONS to Philips on on their 25th anniversary of activity here in Australia, celebrated this year.

To mark the occasion in Sydney, Philips entertained what seemed to be the entire radio and broadcasting world at a series of functions at the Australia during the month, at which guests were able to meet Mr. F. J. Philips, vice-president of the Philips organisation and Mr. T. P. Tromp of the Philips Board of Management.

Both these gentlemen have distinguished careers both in peace and war. Their visit to Australia will no doubt be informative to them, and valuable to their company.

★ ★ ★

UK Atomic Plant

THE British Supply Ministry announced that Britain has built the first atomic heat plant in the world. It is at Harwell Atomic Research Station, where a building containing 80 offices is being heated by an experimental atom pile.

It will replace the heat from 1000 tons of coal per year and save £2650 per year. It cost £15,000 to install, and will equal 200 large electric fires.

Sir John Cockroft, director of the Harwell station, was able to direct the development because Britain has concentrated on the use of atomic power to peace-time projects instead of atom bombs.

The plant is about the same size as an industrial furnace, and weighs about eight tons. Scientists are confident that there is no danger from radio-activity

The Editor and staff of RADIO & HOBBIES wish you a Merry Christmas and a Happy New Year.

Big Flying Boat

THE Saunders-Roe Princess flying boat, Britain's biggest aircraft, is nearing completion. It is bigger even than the Brabazon land plane which has been in the air for 12 months or more.

The Princess, originally intended for luxury flying with sleeping berths and lavish appointments, will be taken over by the RAF Transport Command and used as a troop carrier.

Its first flight is expected to take place early next year. Powered with 10 gas turbines, it will be capable of flying at 380 mph for a non-stop journey of 5000 miles, burning up about two freight-cars of petrol.

Built at Cowes, Isle of Wight, it will weigh 140 tons.

★ ★ ★

Filmless "Camera" For TV

A FILMLESS "camera" developed with money provided by crooner Bing Crosby, was demonstrated to a private audience at Beverley Hills, USA recently.

Electronics engineers John Mullin and Wayne Johnson showed a series of images and sounds that had been recorded on tape simultaneously from a television show.

The engineers said they hoped their invention would revolutionise the film industry and provide television with a cheaper way to reproduce programs.

POPULAR SCIENCE QUIZ

Q. How do geysers and hot springs come about?

A. Although geysers and hot springs differ in their manner of presentation to us, their origin is the same. We know that water filters to varying depths in the earth's crust. This accounts for the steam being present in a volcanic eruption. However, in those parts of the earth's surface where hot rock formations are not too far down, the penetrating water is heated to very high temperatures. The steam produced builds up presure which forces the water back to the surface of the earth where it appears as the familiar hot spring.

In some cases, the upward journey of the water under pressure is difficult, because of restricted passage through rock strata, and extremely high pressures of steam are developed. Eventually the surface of the earth is reached by the water and the sudden liberation throws a considerable volume of water and steam upwards into the air, sometimes to 100ft or more. Once the presure is reduced, the geyser subsides and the whole cycle repeats itself at a frequency depending upon the underlying geological formations at that location.

The upward passage of these hot springs and geysers brings to the surface a variety of dissolved minerals considered to be beneficial to the treatment of certain ailments.

Q. In what way do earthquakes differ from volcanoes?

A. Whereas a volcano is a break-through of lava, steam and other gases at the earth's surface, an earthquake refers to the adjustment of the earth's surface to the unbalanced forces existing underneath.

These internal unbalanced forces are continually adjusting themselves and in the process, rock strata may crack and be tilted upwards. Depending on what is above the rock strata, this crack may carry right through to the earth's surface, leaving a yawning chasm to mark the event. Such activity within the mass of the earth sets up vibrations which are transmitted to the earth's surface by rock formation and which can be detected by a seismograph. From the information given by the seismograph, the general location and intensity of a disturbance can be deduced.

Q. What is the cause of volcanoes?

A. Although the earth's crust has hardened, changes are still taking place within it. The internal heat of the mass of the earth causes expansion and pressures which can be relieved only through "blow-outs" in the earth's crust. At those points on the earth's surface where the internal pressure causes the expulsion of steam, molten rock and gases, we have what are known as volcanoes. The word stems from the Latin "volcanus," meaning "god of fire."

The molten rock, called lava, has a comparatively low melting point and is easily pushed to the surface where, in time, it forms a mountain with long, sloping sides. In cases where the lava cools and solidifies before it leaves the mouth of the volcano, it tends to "plug" the outlet. Accumulated pressure from within may finally blow the top off the mountain and the destruction which results is familiar to most people.

Volcanoes are normally classified into three groups, namely, active, dormant and extinct. At the present time, there are approximately 300 volcanoes which show some degree of activity.

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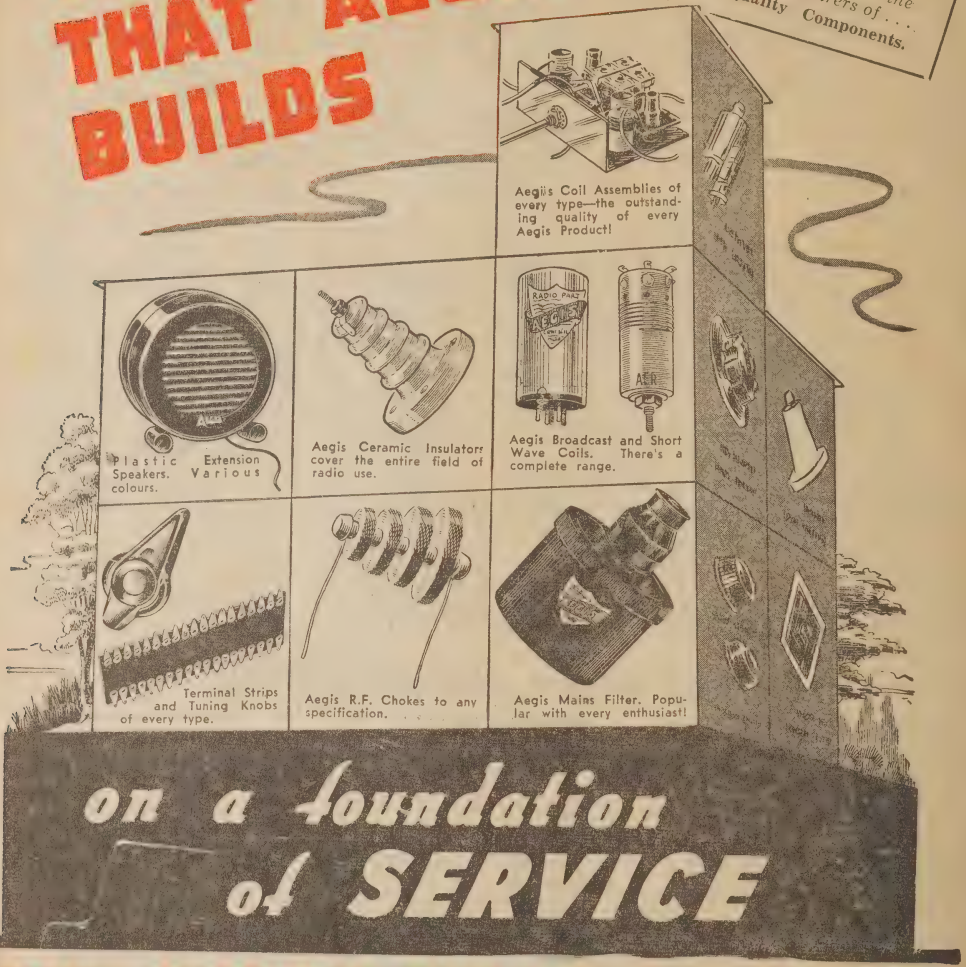
A VERY HAPPY XMAS TO ALL!
is the wish of the manufacturers of . . .
Aegis Quality Components.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Plastic Extension Speakers. Various colours.
Aegis Ceramic Insulators cover the entire field of radio use.
Aegis Broadcast and Short Wave Coils. There's a complete range.
Terminal Strips and Tuning Knobs of every type.
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Homecrafts (Launceston, Hobart, Burnie).

Quieter Aircraft

SCIENTISTS are now working on the problem of making aircraft quieter than at present. Anyone who has lived near an airport will realise the importance of reducing the terrific noise made by big airliners particularly on the take-off.

With the introduction of powerful jet engines, the noise problem is achieving new proportions.

Contrary to popular belief, the airscrew or propellor blades are the greatest source of noise, not the engine itself. Their tips are travelling faster than sound, and set up trains of shock waves as they revolve.

Bigger blades revolving at slower speeds are one possibility, although such a change would be a major one for the aircraft designer.

It seems fairly obvious, however, that the ever increasing volume of air traffic will bring the noise problem to the status of an urgent matter.

★ ★ ★

U.S. Color Freeze

THE decision taken by the Americans to suspend any further action on color television seems to be a wise one.

One of the reasons given was that the pursuit of color would involve a further drain on the country's technical resources at a time when defence projects are all important.

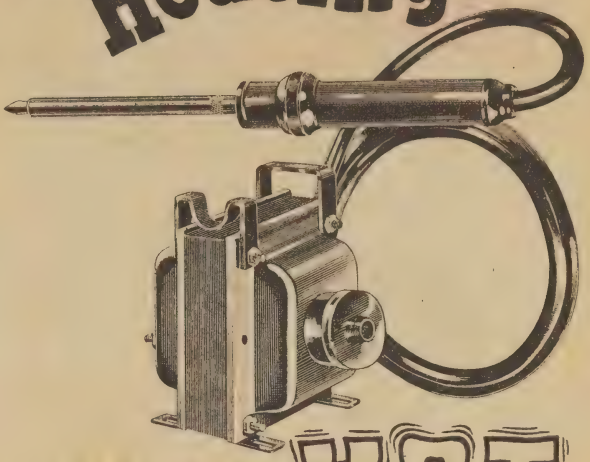
It was bound to tie up an enormous amount of material and effort without any immediate prospect of success, and an undoubted depressive effect on the TV industry as a whole. This effect was being felt by all concerned with color, and sighs of relief are certain to have been heard from all points of the compass.

As the battle for color progressed, the FCC's decision to allow the CBS disc system looked worse and worse. Nothing on the credit side seemed to make any impression on the lack of compatability which was a feature of that system. RCA made big progress with their color tube, despite its complexity in design and manufacture. David Sarnoff hailed it as one of man's most ingenious achievements, and it may well have been all that. Such a recommendation, however, didn't solve the enormous difficulties in making the tubes easily and cheaply.

The last contributor to the color scheme, Dr. Lawrence, whose new tube was described in our last issue, may well have added a last straw. Apart from the comparative merits of the tube—and on the information received it looked most promising — it did show that electronically there was an easier way than that proposed by RCA. David Sarnoff himself has stated that color television "in a commercial sense is principally a conversation piece." Obviously RCA won't be sorry for the opportunity to have another think about it.

Moreover, in England, the PMG has accepted neither FM nor AM as the standard for VHF sound. The chances are that pulse modulation may outdate both systems. That gives us yet another cause for contemplation, not without reference to television plans.

Six Seconds Heating!



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Illustrated literature available on application.

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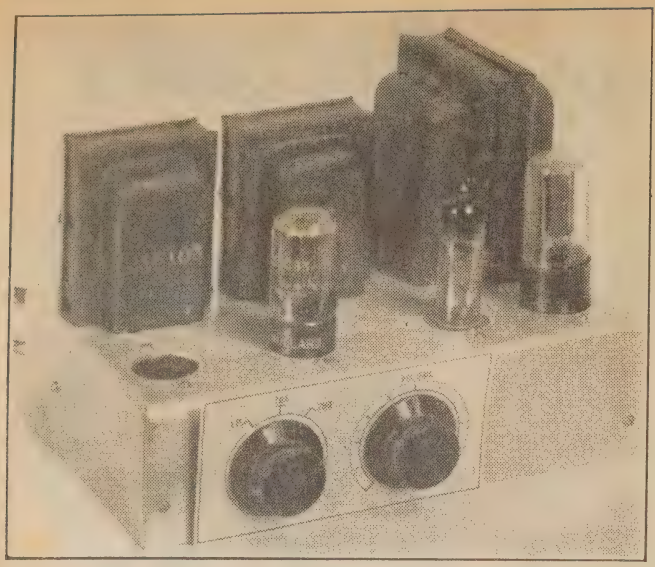


Vacant socket hole is not used unless separate triodes are employed. Pickup is connected by a shield wire although two terminals could be used.

THE BABY PLAYMASTER No. 4

Continuing the PLAYMASTER series, we jump this month from high-powered amplifiers to the first of two 4-watt types, both designed to give high quality output, but with lower maximum power. They cost a good deal less to build, but the standard of reproduction is much the same as with bigger amplifiers.

THE logical progression would have brought us to a circuit for use with the control units and radio tuners. This circuit is in fact under way, and it will be known as the PLAYMASTER JUNIOR, number three of the series. However, just to be different, we have skipped to number four, which is the PLAYMASTER BABY. Its main point of difference from the Junior is that it is a self-contained unit, and is designed primarily for playing records.

VOLUME LEVELS

In attempting to compare large and small amplifiers in the matter of volume, a number of things must be borne in mind. One is often surprised to find that the difference between a single output valve, such as used here, giving a power output of 4 watts, and a large job, giving 10 or more watts, isn't as much as might be expected. But as a matter of fact it requires quite an appreciable change in volume, one way or the other, before one can notice the difference. Various estimates of this amount of change have been made, varying from 1.5 to 3 db.

Now 3 db in power is equal to a change of 2-1, equal to a drop from 10 to 5 watts. So that although this amplifier won't give more than about 4 watts flat out, it isn't so much below the big jobs as one might think.

Without buying an argument on this point, it might be more useful to say that nearly all commercial radiograms sold today use output valves with approximately 4 watts maximum output, so that the BABY will make about the same amount of noise as they do.

Another factor in this output business concerns the efficiency of the loud speaker. A modern high-grade 12-inch type, having a large magnet structure, is much more efficient than less costly types and old-fashioned designs. A good speaker attached to this amplifier in an average-sized room, would overpower almost any listener. So don't get the idea that because it has a modest power rating it won't make plenty of noise.

Naturally, this amplifier is going to cost a good deal less than the bigger types because it has fewer valves and smaller power equipment. If you really haven't any use for high power, it's very hard to overlook this point. Particularly as we have taken some care to preserve good audio quality.

The fact that it is self-contained makes it handy in many ways. You can stow it away beneath the motor board in a small table type cabinet just as easily as you can mount it in a larger one. You can even hang it from the motor board with only two controls showing from the top if you wish, as it's not very large and could be made even smaller without much trouble.

THE CIRCUIT

The circuit is really a combination of the Control Unit No. 1, with a power supply and an output valve. In addition to the volume control, it has a switch which provides correct compensation for LP 78 American and 78 British records, and it will work with almost any type of magnetic or crystal pick-up.

The valves we have selected are those which will provide the greatest sensitivity, and it is probably wisest to use them if building from scratch. However, quite a few additional combinations will give good results with very minor changes to component values. We will have more to say on this point later, but it is one more feature of the flexibility of the PLAYMASTER BABY.

The circuit is essentially a twin-triode valve connected as a two-stage amplifier, driving a beam output valve.

The first triode section accepts the input from the pick-up, amplifies it and feeds it into a tone compensation circuit which provides the correct amount of bass boost and treble cut to compensate for the various recording curves. The input to this stage is 50,000 ohms, which is about right for almost any of the magnetic pick-ups.

COMPENSATION

The compensation is selected by means of a two-circuit switch, with three positions. One circuit connects bypass condensers from the first triode plate circuit to ground, and the second varies the value of the bass boost condenser.

With this type of boost circuit it is necessary to use a voltage divider across the first triode output to reduce the voltage supplied to the next stage by about 10-1.

As explained in last month's issue,

by John Moyle

the rising reactance of the boost condensers in series with the divider effectively increases the value of the lower half as the frequency decreases. This reduces the voltage "stepdown" ratio so that, at very low frequencies, almost the full gain of the stage is available.

The first triode section and the output circuit comprise the first section of the amplifier. The main amplifier is made up of the second triode section and the output valve.

Once again we have used inverse feedback from the voice coil circuit, fed back this time into the cathode circuit of the second triode section. This, of course, reduces the gain of those two valves, lessens distortion by the same ratio as the gain is reduced, and lowers the effective impedance of the output stage.

With the valves as shown, and 20 db of feedback, the amplifier is capable of giving full output with about 130 millivolts of signal.

SENSITIVITY

On this basis, it might appear that there isn't much to spare in the way of gain. In practice, however, it isn't quite that way.

Pick-up output is generally considered as being generated from an ordinary test record. But the peaks of a dance record, for instance, might well reach several times that value. So that, if we are talking in terms of moderate volume, it is possible to drop sensitivity to three or four hundred millivolts, and still get enough sound. It just means that the gain control will most times be well "on."

Even lower gain valves can be used with good effect if you have them and don't want to buy others. Unfortunately the ECC35, which is virtually the same as the 6SL7, isn't always easy to get, and it might be convenient to use another type.

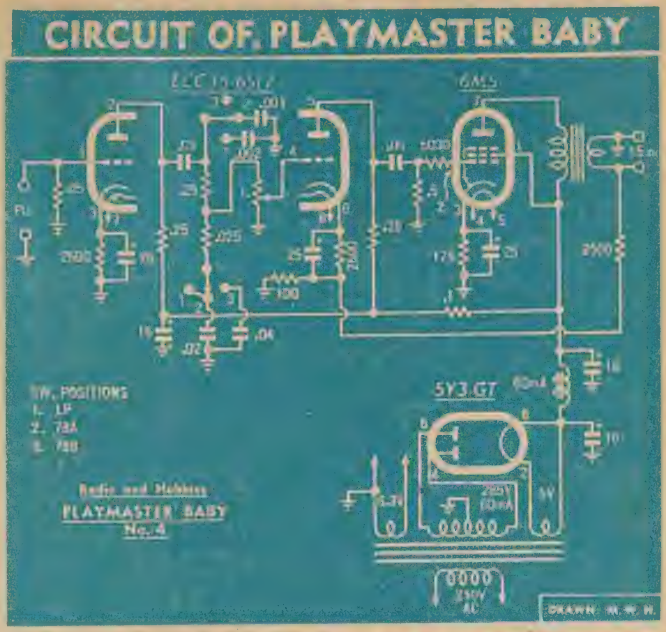
The ECC33 is a twin triode with a lower amplification than the ECC35, but it can be used without any major alteration to the amplifier. Ideally the bias resistors should be reduced to 1000 ohms, instead of 2500, but this isn't essential as the grid swing is quite small. The feedback resistor should be reduced to 1500 ohms, because we have reduced the gain within the loop and must therefore increase the feedback a little. In practice it is doubtful whether the difference in overall amplification will be noticeable, but the feedback factor will be a little lower.

A second variation with still lower gain is to use a 6V6GT in place of the 6M5. This valve will give slightly more output, but is not so sensitive. Its bias resistor will need to be 250 ohms, but no other changes are required, except to lower the feedback resistor to 1000 ohms.

VALVE COMBINATIONS

We found this combination to work out quite well on average recordings, with the gain right open on some quieter discs. It would be quite acceptable in the average home and the virtual impossibility of overload under any circumstances is something which personally I like.

A 6SN7 with a 6V6GT can also be used, but now the gain is beginning to fall a little below optimum. It is still OK if you like quiet music,



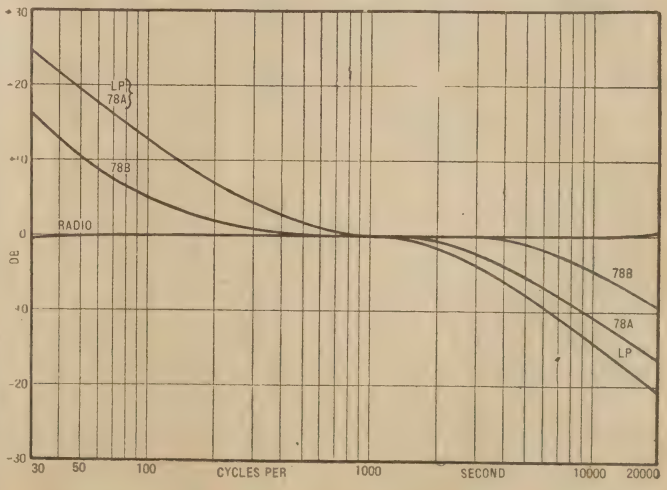
The circuit is quite simple—anyone should be able to build it. Other valve types can be used as described in the article.

but I'd say that for all-round results it's about one step too low. If you have these valves, by all means try them before buying others.

About the only other possible variation would be to use an ECC35 with a 6V6GT output valve. This is about on a par with the ECC33 and the 6M5, and is perfectly OK. The feedback resistor should be 1500 ohms.

From this combination of valves you are sure to find one which will suit. Just remember to use the right bias resistor for the output valve, the right feedback resistor, and possibly to change down to 1000 ohm bias resistors for the ECC33 and the 6SN7. It is doubtful whether listening tests could show any difference in quality between any two variations.

It would be quite practicable to use two triodes instead of a twin type. You will notice a vacant valve socket which, when the chassis is used for the JUNIOR, will accommodate the lead from the control



This graph shows the amplifier frequency response with no treble cut or bass boost, also the response in the three switch positions.

STANDARD -FERGUSON- RANGE

POWER & VIBRATOR TRANSFORMERS

	A.C.		Vib.			Retail
PF 122	240		6	220	40	6.3V @ 2A	61/8
PF 125	240		6	250	60	6.3V @ 2A	71/11
PF 119	240		6	325	125	6.3V @ 4A	102/5
PF 182	240		12	200	40	12.6V CT @ 1A	61/5
PF 126	240		12	250	60	12.6V CT @ 1A	71/11
PF 146	200,30,40		12	325	150	12.6V CT @ 2.5A	120/9

FILTER CHOKES

	Induct	D.C. Res.	M.A.		Retail
CF 100	50	1900	10		33/8
CF 101	30	870	25		33/-
CF 102	15	300	60		25/8
CF 103	30	420	60		48/2
CF 104	30	580	75		51/2
CF 105	15	250	80		43/1
CF 106	12	200	100		43/8
CF 107	30	360	100		59/2
CF 108	12	135	150		61/7
CF 109	20	225	150		64/3
CF 110	12	100	200		74/8
CF 111	16	165	200		74/8
CF 112	10	70	250		74/8

SPECIAL CHOKES

					Retail
CF 113	.5 20	70	250 50	Swinging choke	82/-
CF 114	1.1	23	375	Ballast choke	51/3
CF 115	.017	.6	2 amps	L.T. choke	22/6

OUTPUT TRANSFORMER TO VOICE COIL
Full Frequency Range (30-15,000)

Code No.	Pri. Imped.	Sec. Imped.	Watts	Retail
OP24	5000 SE	8.4, 2.1, with feed back	5	77/-
OP23	3250 SE	12.5, 8.4, 2.1	10	112/3
OP19A	5000 PP	12.5, 8, 2.3	15	163/5
OP51	4500 PP	15.5, 12.5, 8.6, 2.7, 2	20	153/3
OP63	10000 PP	15, 3.75	15	174/6
OP64	10000 PP	12.5, 3.125	15	174/6
OP65	10000 PP	8.4, 2.1	15	174/6

OUTPUT TRANSFORMER TO VOICE COIL
Special Full Frequency (20-30,000)

OP25/40	10000 PP	40, 10	15	183/4
OP25/16	10000 PP	16, 4	15	183/4
OP25/15	10000 PP	15, 3.75	15	183/4
OP25/12	10000 PP	12, 3	15	183/4
OP25/10	10000 PP	10, 2.5	15	183/4
OP25/8.4	10000 PP	8.4, 2.1	15	183/4
OP66	5000 PP	8.4, 3.7	15	219/6
OP67	5000 PP	15, 6.3	15	219/6

OUTPUT TRANSFORMER TO LINE—
Full Freq. Range

OP22	3250 SE	500, 125, 2.3	10	112/3
OP19b	5000 PP	500, 250, 125	15	163/5
OP21	8000 PP	500, 250, 125	15	133/6
OP62	10000 PP	500, 125	15	174/6

OUTPUT TRANSFORMER TO LINE—
Special Full Freq. Range

OP25/500	10000 PP	500, 125	15	183/4
OP25/250	10000 PP	250, 62.5	15	183/4

VIBRATOR TRANSFORMERS

Code No.	Prl. V.	D.C. Out.	M.A.	Buffer Full Sec.		Retail
VT 100	32	200	40	.005	Sync.	50/9
VT 101	6	90	15	.008	"	39/11
VT 102	6	150	25	.005	"	46/6
VT 103	6	200	50	.005	"	49/-
VT 104	6	250	60	.005	"	50/2
VT 105	12	250	60	.005	"	51/11
VT 106	6	300	75	.008	"	82/10
VT 107	6	250	60	.005	Sync. Low Rad.	54/10
VT 108	12	90	15	.008	Sync.	41/5
VT 109	24	90	15	.008	"	43/9
VT 110	12	150	25	.005	"	49/-
VT 111	24	150	25	.005	"	53/8
VT 112	12	200	50	.005	"	51/4
VT 113	24	200	50	.005	"	51/4
VT 114	12	300	75	.008	"	89/3
VT 115	24	300	75	.008	"	90/3
VT 116	24	250	60	.005	"	57/2
VT 117	12	250	60	.005	Non Sync. Low Rad	55/5
VT 119	32	150	25	.005	Sync.	49/2
VT 121	6	180	30	.005	"	51/4
VT 122	6	400	50	.005	"	83/10
VT 123	12	320	125	.005	Sync.	107/10
VT 124	32	250	60	.005	"	56/-
VT 127	6	200	50	.005	Sync. Low Rad.	51/4
VT 128	12	250	60	.005	Sync. Low Rad.	60/8

RECEIVER POWER TRANSFORMERS

Code No.	Prim.	HTV Aside	M.A.	Filaments	Retail
PF 185	240	150	30	6.3V @ 2A	50/2
PF 106	240	325	45	6.3V @ 2A, 5V @ 2A	53/11
PF 198	240	285	50	6.3V @ 2A, 5V @ 2A	50/2
PF 151	200,30,40	285	60	6.3V @ 2A, 5V @ 2A	60/8
PF 165	200,30,40	385	60	6.3V @ 2A, 5V @ 2A	66/6
PF 170	200,30,40	285	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	72/2
PF 168	200,30,40	385	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	69/5
PF 130	200,30,40	285	100	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	77/9
PF 160	200,20,40	385	100	6.3CT @ 2.5A, 6.3V @ 2A, 5V @ 2A	87/3
PF 152	200,30,40	285	125	6.3CT @ 3A, 6.3V @ 2A, 5V @ 2A	97/6
PF 181	200,30,40	385	125	6.3CT @ 3A, 6.3V @ 3A, 5V @ 2A	109/2
PF 174	200,30,40	285	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	102/5
PF 175	200,30,40	385	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 3A	127/9
PF 173	200,30,40	425	175	6.3CT @ 3A, 6.3V @ 2A, 5V @ 3A	197/9
PF 140	200,30,40	385	200	6.3CT @ 3A, 6.3V @ 3A, 5V @ 3A	185/-
PF 171	200,30,40	385	250	6.3CT @ 4A, 6.3V @ 3A, 5V @ 3A	243/7
PF 201	240	225	50	6.3 @ 2A	51/1

LINE TO VOICE COIL TRANSFORMERS

	Pri. Imped.	Sec. Imped.	Watts	Retail
MT111	500	12.5, 8, 2.3	10	69/1
MT100	600	4, 3	15	64/2
MT101	500	15	15	64/2
MT124	600, 500	4, 3, 2.7, 2.3, 2	25	107/10
MT125	600, 500	15, 12.5, 8.4, 6.5	25	105/2

MODULATION TRANSFORMERS

MT118	8000, 6000 PP	10000, 7000 5000	25	169/4
MT119	8000, 6600, 3800 PP	10000, 7500, 6500 5500, 4500, 3500	50	195/1
MT120	500 to 20000 in steps.	500 to 30000 steps.	50	356/10
MT121	500 to 20000 in steps.	500 to 30000 steps.	125	444/-

Output Transformer To Voice Coil—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1	5000, 2500 SE	12.5, 8, 2.3	10	71/3
OP54	5000, 2500 SE	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	10	82/3
OP39	5000, 2500 SE	15	10	72/6
OP33	5000, 2500 SE	5, 2.7	10	72/6
OP41	5500 SE	3.7	10	81/1
OP53	30000, 20000 14000, 10000, 7000 5000, 2500 PP	2.3	10	70/1
OP2	5000 PP	12.5, 8, 2.3	15	109/11
OP55	5000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	120/5
OP3	6600 PP	12.5, 8, 2.3	15	109/11
OP56	6600 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	120/5
OP4	10000 PP	12.5, 8, 2.3	15	109/11
OP57	10000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	120/5
OP5	10000, 6600, 5000 PP	12.5, 8, 2.3	15	109/11
OP58	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	121/11
OP59	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	25	152/9
OP60	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	32	195/-

OUTPUT TRANSFORMER TO LINE—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1A	5000, 2500 SE	500	10	71/3
OP44	5000, 2500 SE	500, 250, 125	10	84/8
OP34	5000 PP	600, 300, 200, 150, 130, 100 75, 50	15	131/-
OP6	5000 PP	500, 250, 125	15	109/11
OP7	6600 PP	500, 250, 125	15	109/11
OP50	8000 PP	600, 300, 120, 60, 30	15	228/4
OP8	10000 PP	500, 250, 125	15	109/11
OP8M	10000 PP	500, 250, 160, 125, 100, 83.5 71.5, 62.5, 55.5, 50	15	118/6
OP9	10000, 6600, 5000 PP	500, 250, 125	15	109/11
OP10	5000 PP	500, 250, 125	25	132/6
OP11	6600 PP	500, 250, 125	25	132/6
OP38	6600 P	600, 300, 250, 200, 170, 150 76, 50, 36, 27, 12.5, 7.5, 3.6, 2.7	25	228/4
OP12	10000 PP	500, 250, 125	25	132/6
OP13	10000, 6600, 5000 PP	500, 250, 125	25	132/6
OP35	10000, 6600 PP	500, 4000, 8.4, 2.2	25	187/4
OP14	5000 PP	500, 250, 125	32	161/-
OP48	6600 PP	140, 70	32	195/1
OP15	6600 PP	500, 250, 125	32	161/-
OP15M	6600 PP	500, 250, 166, 125, 100 83.5, 71.5, 62.5, 55.5, 50	32	162/6
OP16	10000 PP	500, 250, 125	32	161/-
OP17	10000, 6600, 5000 PP	500, 250, 125	32	161/-
OP36	3800 PP	17.6	60	171/-
OP18	3800 PP	500, 250, 125	60	173/4
OP61	3800 PP	100, 75, 50, 25, 10, 5, 2	60	223/-
OP37	6400 PP	500, 250, 125	80	236/3
OP49	8800, 6000 PP	500	105	355/10
OP20	11600, 8400 PP	500, 250, 166, 125	150	451/-

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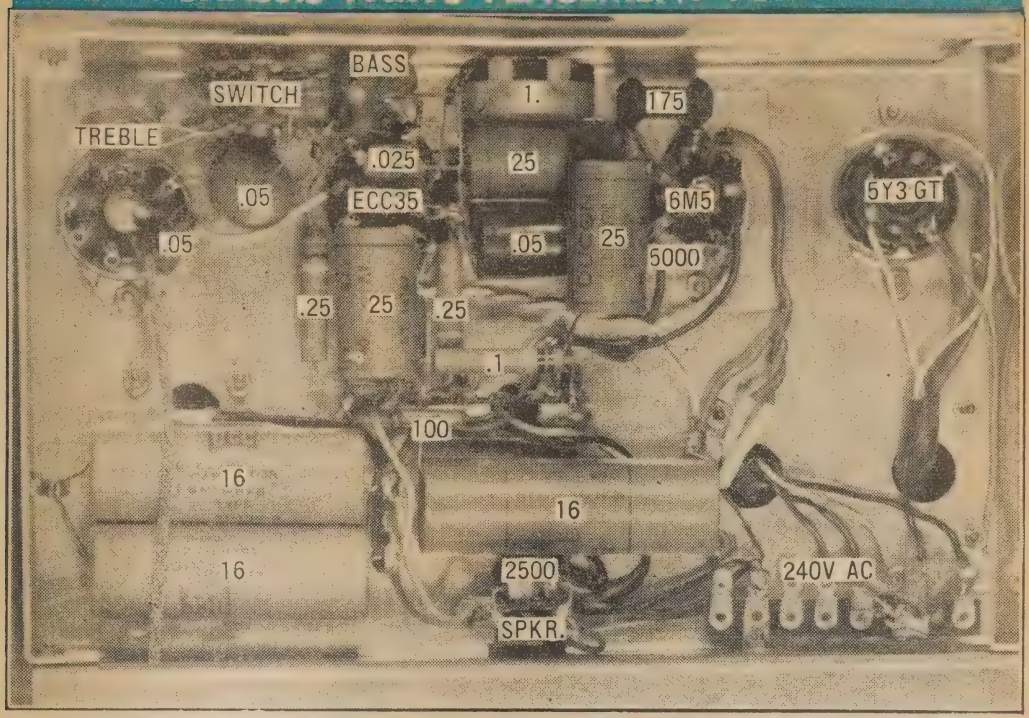

To assist in construction, this picture shows the layout under the chassis. Treble cut and bass boost condensers are grouped round the switch. Unused socket anchors pickup lead and input resistor.

unit. This socket could be used for the extra valve.

For instance, two high-gain triodes can be used to replace the ECC35, two medium-gain triodes instead of the ECC33, or even one high and one low gain triode. From our previous remarks you will be able to estimate just how much overall gain you are likely to get from any combination, and there are no complexities in wiring two valve sockets instead of one. Always try the valves you have first, as circuit changes cost practically nothing.

OUTPUT TRANSFORMER

A single-ended stage normally gives higher distortion than a push-pull equivalent. There is none of the push-pull cancellation of even harmonics for one thing, and life is somewhat harder for the output transformer for another, as we can't arrange for balanced plate current through the windings as with push-pull.

However, the use of about 20 db of feedback (10 times), together with the fact that most times the amplifier will operate well below its full output, still allows us to expect a figure of probably 1 pc or lower.

Distortion in the triode stages is not high, and in any case one stage tends to cancel out the other. With 1 millivolt from the pickup, the output voltage of the first triode won't be more than about 4 volts, or one-tenth of maximum. About the same output is required from the second triode to swing the 6M5, added to which the second triode is also within the feedback loop. So we can just about forget distortion here.

A good output transformer is a wise investment in a single-ended stage. Fortunately, there are some excellent types available with a rated range of 50-10kc or even 30-15kc. We used a 15 ohm voice coil, but you will select a transformer with the correct ratio for your own speaker.

Used with a 3 ohm voice coil or thereabouts, the feedback resistor will need to be reduced by about one-third its present value, and for a 2.3 or 3 ohm coil by about two-thirds.

The volume control is placed between the two triode stages to avoid having the residual noise and hum of the first triode present in the circuit all the time, small though this amount might be. It also avoids the possibility of overloading the second triode on peaks from the first. With such a high gain valve, Miller effect might be expected to bring about attenuation of the higher frequencies, but apparently due to its inclusion in the feedback network, the drop at 10kc with the gain control half-way advanced is only about 2 db. There is little of this trouble in the first stage because of its low input impedance of 50,000 ohms.

It is most important when building to see that the grid pin on the valve socket next to the filament pin connects to the pick-up input circuit. Although the gain is highest at this point, its impedance is low and there is no tendency to pick up hum from the filament circuit. If this grid is connected into the high impedance grid circuit of the second triode, mid-position hum on the volume control is inevitable. We know, because we tried it. The filament should be earthed at this pin, number two on the triode socket as a further precaution against hum pickup.

With full bass boost and the gain wide open, residual hum should be negligible.

RESPONSE

The compensation circuit provides for the standard amount of bass boost and treble cut required by the recording curves. Because of the slight drop in highs through Miller effect, no extra attenuation is provided for on British 78 records. Generally speaking, the volume control will be operated in this position, and the desirable top cut is small in any case.

The frequency response of the amplifier is very flat. It only just begins to drop at 50 cycles and varies less than 1 db up to 25kc with the OP 24 transformer, with an almost constant output all the way. This must be regarded as a very good performance.

Goldring

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Microgroove enthusiasts are all welcoming the remarkable Goldring 3 speed record player. It is a quality instrument that will convert an ordinary radio or single speed radiogram into a 3 speed player playing the new 33 1/3 and 45 records with the same clarity of tone that it does with the ordinary "78" discs. Features the world-famous "B.S.R." GU4 motor and pick-up unit. You simply plug it in.

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3 SPEEDS
78, 45, 33 1/3 r.p.m.

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This superior unit is built by Birmingham Sound Reproducers Ltd., England, and radio manufacturers all over the world have selected it for its quality, style and performance. Little wonder that the GU4 motor is preferred by record enthusiasts everywhere.

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Even with a standard PA transformer, the response should be flat up to about 10kc or even higher, due to the large amount of feedback, and with only a little greater loss at 50 cycles.

POWER SUPPLY

The power supply for the amplifier consists of a standard 60 mill type power transformer at 285 volts per side and a 30 henry choke of the same rating. Two 16 mfds. filter condensers are adequate.

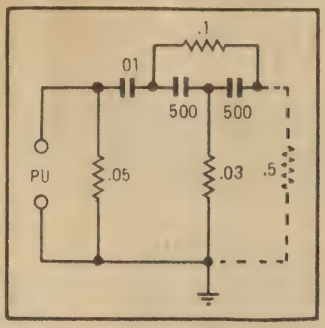
The two triode sections are decoupled through a common resistor, and another 16 fmds. condenser. A smaller valve could be used, but it is just possible that slight motorboating might happen with the volume full out.

Should you be troubled this wey, a complete cure can be made by running the decoupling resistor directly from the rectifier filament, in which case the 16 mfds. is really necessary to keep the hum level down. It is, however, extremely unlikely that you will be worried in this way.

The hum level of the amplifier is very low indeed, and about on a par with the larger types. Unless you are right up against the speaker you cannot tell whether the amplifier is turned on or off.

There should be no constructional problems with the amplifier. The chassis measures 9½ x 6 x 2½ inches and the 6in measurement could be reduced by probably one inch if required. However we will use the same chassis for the PLAYMASTER JUNIOR and the blue-prints will be made on this basis. If you cut your own chassis, the layout will be obvious from the illustrations.

The suppressor in the output valve grid circuit may not always be needed—it is included more as a precaution. If a 6V6 is used, it can almost certainly be left out, as we have found this valve stable under almost any conditions. With the higher gm 6M5, however, there is a little more risk.



This circuit is recommended for use with the GP20 pick-up and the pad is connected between the pick-up and the amplifier. It is a good idea to mount it in a small aluminium box bolted to the chassis to reduce danger of hum pick-up. Or it could be mounted inside the chassis on the end nearest the switch.

SUPERSPEED SOLDER

Solder is a vital commodity in thousands of commercial processes including, of course, radio and electronic equipment of all kinds. But solder isn't just a bar of soft metal applied with the aid of spirits of salts.

J. H. Magrath and Co. Pty. Ltd. are making this point most effectively when introducing Superspeed solder made by the old-established English firm of H. J. Endhoven and Sons.

Of main interest to radio men is the Superspeed White Flash activated core solder, which not only has a scientific blend of lead and tin, but features a star-shaped rosin flux insertion, makes soldering fast and certain.

This solder is also made with colored cores, a process claimed to greatly faciliate inspection and identification without in any way affecting the efficiency of the soldering process.

Mr. Jim Magrath illustrated this point recently by showing an excellent film in color produced by Endhoven's when he introduced the solder to the trade in conjunction with Mr. H. H. Peaston, who is handling it for NSW.

The solder is obtainable in all gauges, some as fine as 16 gauge.

Endhoven's also make a wide range of solder in all forms for general commercial use.

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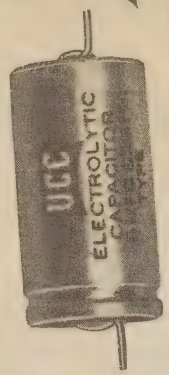
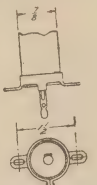
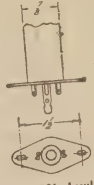


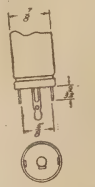
Type 51-130. Pigtail Type—universally used in any position where capacitors can be supported on tinned copper pigtails. Capacitor body is insulated.



Type 51-134. Flanged Clamp — used where above chassis mounting is required and capacitor is earthed. Capacitor body is not insulated.



Type 51-126. Insulated Flange—used for above chassis mounting and where capacitor is insulated for bias supplies. Capacitor body insulated.



Type 51-101. Twist Lug—used for above chassis mounting by inserting lugs through slots and twisting to hold in position.

SPECIFICATIONS

1. Capacity Tolerance: — 10% + 40%.
2. Power Factor: 15% max.
3. Max. Operating Leakage: 0.1 mA/mfd.
4. Max. Operating Temp.: 145° F.
5. Electrolyte: Semi-dry.
6. Container: Hermetically Sealed Aluminium.

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Radio without tears

There always seems to be room for another book on radio. Even a simple explanation of what makes it tick. Which underlines the fact that it isn't the material that need be new, as much as the way it is said.

THOSE of us who have spent some time in radio and achieved reasonable familiarity with most of its basic facts are apt to forget sometimes that the newcomer has yet to absorb fundamentals which to us have become commonplace.

It is hard for the engineer to imagine that Ohms Law could possibly present any problems to anyone. It is true, too, that such a one is generally not the ideal person to write a book on elementary radio.

John T. Frye, author of "Basic Radio Course" agrees with this. He thinks that too many who write books on radio theory use engineering jargon which makes a mystery out of simple things. Either that, or they are "written down" to such an extent that the reader's patience suffers.

His book is a highly successful attempt to strike a balance between these two extremes. He realises the necessity to build up in the reader's mind a mental picture of what goes on as well as to instil the simple mathematical background which allows him to make use of what he has learned.

In so doing he has achieved an informal style which is not above introducing a few humorous touches where appropriate when the going shows signs of getting tough.

His book of 172 pages commences with electron theory, passes to general theory, treats matters such as valves, power supplies, loudspeakers, circuits, and servicing in a logical style, building up just that background which allows the reader to go on to more specialised study with a realisation of where it all fits in.

Basic "Basic Radio Course" is a Gernsback Library publication No. 44 by Radcraft Publications Inc. 25 West Broadway, New York. Our copy was from the publisher.

BRASS WIDOW'S LAMENT

There are notes and circuits scribbled on the wall
And a twelve-inch speaker standing in the hall—
Can you wonder why my teardrops start to fall?
I sure don't get no luvin' now at all!
There's a chassis and a key upon the floor
And resistors and condensers by the score
I'm sure that man don't love me any more.
There's a sched. he's gotta keep from "WV"
And a drop of choice DX right after tea.
There's an acorn where his heart oughta' be!
Don't worry! He won't make a bloomin' Ham o' me!

(Mrs. Constance Waters, c/o Darwin Hospital.)

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Let's Buy An Argument

The current series of articles by the Editor, describing the "Playmaster" amplifiers, have prompted a good deal of discussion and I am taking it upon myself to answer a few readers who haven't altogether seen eye-to-eye with our approach.

by W. N. Williams

THE reception accorded these amplifiers has thus far been most enthusiastic, because they reflect an obvious and sincere effort to achieve well-balanced, high-quality reproduction with circuit arrangements which are no more involved nor tricky than they need to be.

One or two readers, however, have been perturbed because we elected to describe a new basic amplifier, rather than stick to the Williamson circuit. One correspondent from Nowra even dragged me into the matter. He says:

"With the advent of 'Let's Buy An Argument' I felt that, by a process of elimination, we would soon come to expect a gathering together of loose talk and a belated presentation of a recipe for perfectly faithful reproduction. In its place we are asked once again to expect 'A New Deal In Amplifiers'....

"It is also suggested that we should not rely on our intelligence, knowledge or experience when listening to music because our ears are tricky things and apt to lead us astray... Our earnest suggestion is that you accept the Williamson amplifier in all its glory as basic and basically sound and concentrate more on fidelity requirements..."

Now I won't deny that the whole idea of this "Argument" feature is to stimulate thought and discussion (often abstract) and, amongst other things, to promote a better understanding of the factors which still limit sound reproduction. But that doesn't mean that we must be intolerant of decisions and designs which accept practical limitations as we now find them.

What would happen if we took our friend from Nowra at his word and proceeded to present for his special benefit *"a recipe for perfectly faithful reproduction."*

We would have to arrange for the services of a special orchestra to make new recordings and be very fussy about the choice of a building in which they could perform. We would need to instal very special microphones and amplifiers on the off-chance that there is something in the theories about our reactions to supersonic frequencies.

As a medium of recording and playback, we would probably have to provide some very expensive high-speed tape machines, because it is doubtful whether any other medium would lend itself reliably to the recording of supersonic tones and with a complete absence of background noise.

The Williamson amplifier might just get by but the speaker system would probably cost several hundred pounds because nothing cheaper than that could be expected to have the necessary frequency range and freedom from distortion. Add a specially designed listening room and your system would be as near perfect as you could make it.

Can you imagine the reaction of readers to such a proposition. "Fair go mate.... The best I can afford is a microgroove record, a Goldcos pickup and an Ampli-Rol-Jen speaker."

"Oh," but I say, "you can't use them. They'd introduce 10 or 20 pc distortion straight away."

Exactly! Until distortion-free auxiliaries are available to the listening public it is COMPLETELY IMPOSSIBLE to originate a recipe for "perfectly faithful reproduction." and while that position exists it is perfectly legitimate to design and specify amplifiers which are of such a nature that any limitations they exhibit do not deteriorate to a noticeable degree the results as determined by the rest of the gear.

That seems to me a perfectly logical line of reasoning but no... a few diehards still persist with the "perfect amplifier" theme and go on to quote the Williamson circuit as the obvious, the inescapable and presumably the permanent answer.

But why stop at the Williamson if you think this way? It isn't perfect either. You can build a lot better amplifier with twice as many valves, several more feedback loops and much more expensive transformers. A lab. worker in Los Angeles has just finished a beauty which has a peak distortion of 0.0011 pc second harmonic with 60 watts across the output secondary.

"Oh, but that's too expensive," you retort. "I couldn't afford to build it and there are too many tricks in the circuit. The Williamson is as good as I'm ever likely to want...."

Which, of course, puts you in precisely the same position as you condemn us for occupying, except that your compromise of performance versus complexity is different from ours. Funny, isn't it? Even the Williamson is a compromise.

"Et tu, Brute . . .!"

No, we haven't any illusions about the Williamson. Electrically it's fine —mighty fine. But it IS expensive to build and it IS tricky to use with equalising stages. The crime with which we are charged is that of making your life a little easier.

Fortunately, there are plenty of readers who see things our way, otherwise there would be a danger of us printing 20-million copies of the Williamson circuit to cope with all future amplifier needs.

IN THE NEWS

Poor Williamson! His ears must now have been reduced to blackened embers, from the number of people who've been talking about him. On the other hand, he might like publicity!

Our friend and erstwhile contributor, Phil Edwards, has come to light with a circuit prompted by these same considerations and we reprint it as a matter of interest. It uses a pentode voltage amplifier, a cathode coupled phase inverter and 807's as triodes in the output. Negative feedback operates from the voice coil winding back to the first cathode and P.E. claims similar results to the Williamson with much less circuit complication.

One might argue that the feedback factor isn't quite as high or something else is different but I would expect to find that you could rig this amplifier and our own "Playmaster" alongside the Williamson, connect them all to an identical pickup and equalising system, feed them into the same speaker and find it completely impossible to tell one from t'other at room volume.

Just in case I get picked up on the ear-versus-instrument angle, let me hasten to add that a calibrated microphone set-up would probably not be able to tell much difference between them either, when analysing the signal from a test recording.

HIS OWN IDEAS!

But don't get the idea that friend Edwards has submitted the circuit because he's a "yes" man. In fact, he attacks both ourselves and Williamson for the use of a conventional phase splitter. He says:

"The laborious static balance of the Williamson output stage and the balance of the penultimate voltage amplifiers is rather amusing when considered in the light of the phase inversion system used . . ."

". . . in respect to this feature, I must remain your implacable technical enemy; I refer, of course, to the single-legged phase splitter. There is no point in thrashing out this system—you are aware of its inherent defects as I am but it is quite obvious that Williamson got into difficulties with it at the outset . . . This (gainless) phase splitter and its accociated direct coupling seem to be a most retrogressive approach to the problem. . . ."

It grieves me to think that I should be regarded as the official protagonist for the phase splitting circuit and the guardian of retrogressive ideas!

It grieves me to be credited with knowledge and yet branded as unwilling to move with the times!

It grieves me to think that my partial namesake, one Williamson, should be guilty of the same things under the mantle of greatness!

Either that or Mr. Edwards is himself laboring under some slight misapprehension.

What makes it all the more difficult is that another reader has been most upset by Mr. Moyle's implied insult against the phase splitter. I quote from the said reader's letter.

"Again, an excerpt from page 41 (October issue) indicates that a little more time could have been spent with the valve charts. . . . We have found that push-pull drivers &c. . . . When driven from a phase changer, &c . . ."

For goodness sake, who's right and who's wrong? I think I can guess where all the confusion has arisen.

THE EXPLANATION

You set up a phase splitter and, in order to check it for balance, you measure the output across each section of the load with an accurate voltmeter or perhaps a CRO. Lo and behold, the readings differ by a certain amount, no matter how carefully you match the two resistors! Conclusion? The thing is unbalanced, valve engineers &c. notwithstanding.

One might be excused for drawing the said conclusion, but there is a very simple explanation for it.

Negative feedback operates in respect to both output legs and incidentally ensures low inherent distortion—one of the features of the phase splitter.

Now it so happens that the feedback is of the "voltage" variety in the cathode leg and of the "current" variety in the plate leg. As a result, the apparent impedance of the cathode leg as a source of audio signal is lower than that of the plate leg. They therefore react differently when separately loaded.

DIFFERENT READING!

So it is that, when the load represented by a measuring instrument is connected across each leg in turn, a different reading is obtained, the discrepancy becoming more marked as the impedance of the measuring instrument is reduced.

To make an accurate reading it is necessary to use a high impedance indicator to begin with and to load the opposite leg by the same amount to preserve the balance of the stage. Then, me thinks, you'll find nary a whisker of difference between the two.

In an ordinary push-pull amplifier, the load across each leg of the output is identical, being represented by the ideally infinite impedance of the grid itself and (usually) a 0.5 meg. grid resistor.

You can match resistors, if you are fussy, on a suitable ohmmeter and rest assured that delta Ip flowing through Z/2 will produce e/2 volts across each leg.

READER LIKES OUR IDEAS

Dear Sir,

I was very interested in the troubles of your correspondent, J.A. as published in the September issue and also the article "A New Deal in Amplifiers" by Mr. John Moyle, in October.

I can thoroughly endorse every finding of these gentlemen. I too made up a "Williamson" and it was the first amplifier I ever made (also the last, as I haven't essayed since). A bit ambitious, however! It worked from the start, but I had all the troubles mentioned by Mr. Moyle, motor-boating at low frequencies and supersonic oscillation at the other end.

However, I am one of those naturally poor mental types who pick other people's brains instead of using my own inadequate supply, and I watched Radio and Hobbies and applied ALL the corrections given from time to time therein.

The result is a splendid amplifier which just couldn't play up if it tried. It's shackled hand and foot—half usual feedback, resistor in 1st valve grid, trap circuit in plate supply to same, separate power supply for pre-amplifier, and, finally, my own dodge of separating the cathodes of the 807's each with its own resistor instead of strapping them together.

Now the poor thing is on its back quite helpless, couldn't oscillate no matter where it was prodded.

Despite this I agree with Mr. Moyle and would not make up another, not because it isn't good, it certainly IS, but because it's TOO GOOD. For a laboratory research worker the Williamson is the job, flat from 2CPS to 50 grand. But, as John implies, it's sending a man on a boy's errand for audio reproduction.

Then I had all the troubles of J.A., thin bass, impossible scratch and noise on old records, and, after doing the same as he, and buying a Goodmans, the troubles became worse. I even had the Axiom specially tested for faults, without, of course, any result.

I made up the preamplifier with bass and treble cut and boost. Then a top cut filter, tried variety of pick-ups, including HMV Lightweight, Goldring Headmaster and then an Acos GP 20.

Now I can play any record from an early Caruso to the latest L.P. and get practically the most possible out of them. I emphasise "practically" because, while I think the "Caruso" couldn't be improved on, I know the wide range modern recordings could be, with a battery of multiple frequency divided speakers (I use two extra, as well as the Goodmans, for orchestral reproduction) and also with use of ribbon type H.F. speakers.

As Mr. Moyle says: It's a science all right and you just can't get full results these days unless you treat it as such.

Yours faithfully,
C.W.W.
Lakes Entrance, Vic.

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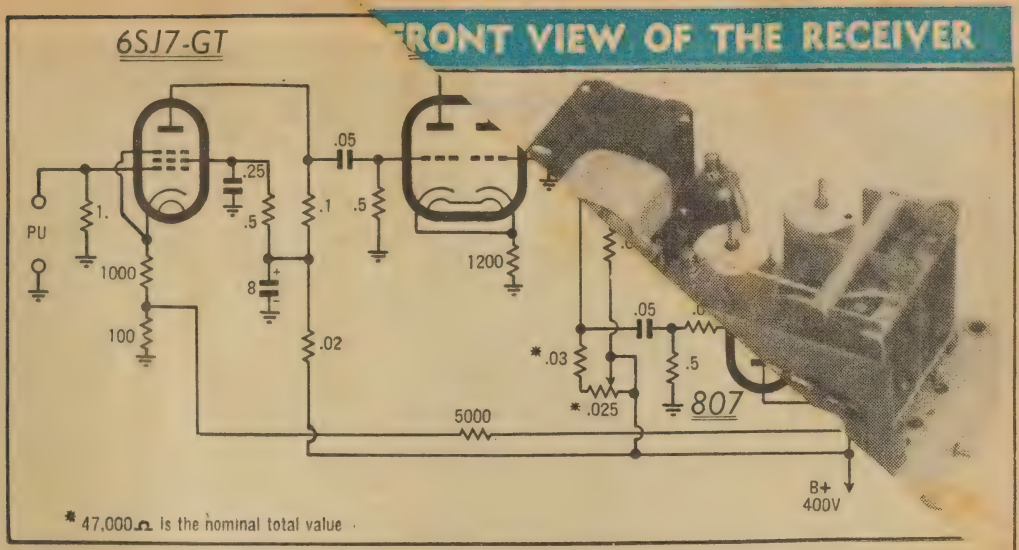


Mr. Phil Edwards' amplifier, referred to in the article, is quite a good one.

In other words, you have a phase splitter which is simple, self-balancing and introducing a minimum of distortion and phase complication. Maybe that's why people still use it!

However, that's not the end of the story. The phase splitter works like a charm into push-pull pentodes, for example, because their signal requirements are modest and they don't have to be pushed into grid current to realise high output and high plate efficiency. Study the load curves and you'll see why.

Triodes, however, are often a different story and particulary those of the 6L6-807-KT66 variety.

In order to obtain even reasonable plate output and efficiency it is necessary to swing their grids into a region where they do draw some current on positive peaks. When this happens, the "balanced loading" requirement on the phase splitter is upset and the valve driven from its plate receives a signal whose peak is rounded off in a most perturbing fashion .

In other words, the phase splitter is DEFINITELY UNSUITABLE as a drive source to valves which normally draw any grid current over any portion of the cycle. I must stress the word "normally" because it applies to the Williamson and to any other amplifier which obtains equivalent power from triode-connected 807 type valves.

You may have noticed, from published figures, that the total current drawn by the Williamson is surprisingly much lower at maximum output than it is when quiescent. The reason is simply that the valves draw grid current and charge the coupling condensers sufficiently to change the operating point of the tubes.

Thus, 807 triodes and other like stages must be driven from a low and balanced impedance source. Mr. Williamson did it with push-pull drivers, while Mr. Edwards chose the cathode-coupled phase inverter—both perfectly legitimate schemes.

Mr. Moyle merely pointed out that the phase splitter wasn't suitable without going into details, much to the consternation of the aforementioned reader from Nowra.

He elected instead to use the valves as tetrodes, thereby doubling their output power for the same input voltage and current. He reckoned that, with best part of 20 db of feedback in action, the performance of tetrodes operating at say 25 pc of full power would be at least as good as the same valves as triodes with only a 50 pc margin.

It so happens that the phase splitter is PERFECTLY SATISFACTORY for this application.

"GAINLESS" PHASE SPLITTERS

We could have used push-pull drivers but it would have made the circuit more complicated to no purpose.

We could have used the cathode-coupled phase-splitter or yet another variant which yours truly doped out while we were analysing the whole problem. That again would have meant specifying a twin triode and a balance adjustment without any apparent improvement in performance.

Had we elected to pursue the triode scheme, we would have reversed the decision. I know, because we tried it!

Finally, there is the question of gain and these dark aspersions against "gainless phase splitters." Let me say right here and now that nearly every phase inverting stage I have ever come across is open to the same charge, because the gain of at least one valve is absorbed in changing the phase.

Taking Mr. Edwards circuit values and the cathode coupled stage, the gain from the input grid to the grid of the upper 807 would be approximately eight times, allowing for the rather low plate load and the cathode circuit degeneration.

Assuming that the circuit is adjusted to give a balanced output drive, the gain from inverter input to the push-pull grids could be set down pretty accurately as 16:1.

Now take the ordinary phase splitter. One triode, operating with equal plate and cathode loads gives a gain of 1.8 from input grid to push-pull output. That doesn't sound much but remember that only one triode section has been employed. If we also specify a twin triode and use the first one as an amplifier, a gain of 14 times is immediately available, making the net gain from the same twin triode equal to 25 from input grid to push-pull output.

So, if gain is to be a determining factor of merit, then it's a poor look out for the cathode-coupled circuit with an overall of only eight. Even the twin-triode paraphase system can muster a gain of 14, using the same valve.

There are occasions where gain is important, as it might be if you were designing an amplifier using say one 6SN7 and a pair of 6M5's. The phase splitter would then be the best choice.

In other cases, gain from the phase splitter may not be necessary—or it may even be a nuisance!

Then again, as with 807 triodes, it may be essential to obtain a balanced low impedance drive and the phase splitter is immediately ruled out.

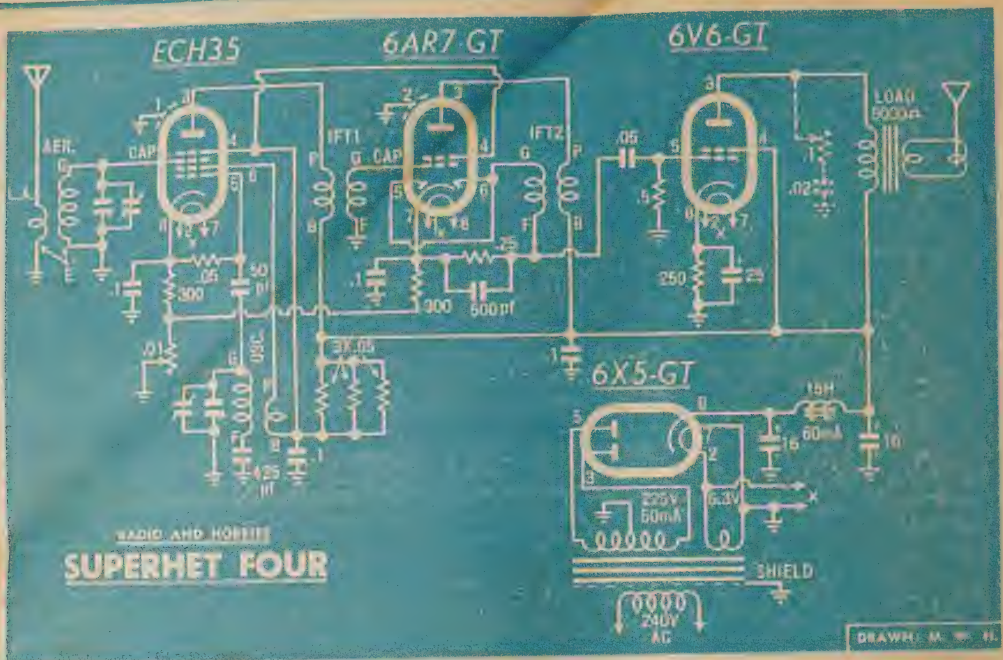
CHECKING PERFORMANCE

You see it all depends on what you need for the particular job on hand.

One final point. For Heaven's sake don't fall into the trap of trying to analyse the performance of any stage in a feedback amplifier with the feedback still operative. The reason is simple.

If the output valves overload first, as they most likely will, a portion of the distorted output will be fed back to the input and duly amplified. Unless you are awake to what is going on, you may be prepared to swear that one of the early stages is overloading. Interstage operation can only be separately analysed with the feedback disconnected. A lot of confusion arises that way.

Well that's that. I trust the foregoing doesn't read like the writings of a bigot or even the effort of one who defends the indefensible. I hope, with equal sincerity, that none of my verbal combatants will be reduced to the position of admitting the facts but still not agreeing herewith.



The circuit of our "Superhet Four." It does not contain a gre at deal more than our earlier designs and should be quite easy to follow in conjunction with the wiring diagram.

Last month we discussed the superhetrodyne — why it is such an attractive proposition, what it will do, and how it does it. We also promised that, this month, we would tell you how to build one for yourself. Well, here it is, the "Superhet Four," the final design for this project of "Learn While You Build It," and one we think you're going to like!

LEARN WHILE YOU BUILD

by Philip Watson

FIRST, a few words about the circuit, just to tie it in with the explanation we gave last month. As we intimated then, it is very similar to the circuit we "exploded" for explanatory purposes, except that it uses more modern valves, including those you have already bought.

There is one additional valve, the ECH35, which is a frequency converter similar to the 6J8. As a matter of fact, we chose this type in preference to the 6J8, mainly because it seems to be in rather better supply at the moment, but a 6J8 could be used if available.

THE CIRCUIT

Following this is the 6AR7 (similar to the 6G8-G), which performs the dual function of IF amplifier and diode detector. This passes the signals on to the 6V6, which operates as a power output valve under exactly the same conditions as in our previous sets.

Volume control is by means of a 10,000 ohm variable resistor in the cathode circuit of one of the ECH35 and the 6AR7. In other words, we use a variable bias resistor. These valves are so designed that their amplification may be varied by varying the bias, and are known as variable-mu valves.

Although the sensitivity increases as the bias is reduced, there is a definite minimum below which it is not advisable to go, owing to the danger of over-running the valves. This figure is given by the valve manufacturers and is usually in the order of two or three volts. To preserve this minimum you will notice that each cathode has a 300 ohm resistor between it and the variable resistor, and this effectively prevents less than the rated voltage bias being applied.

It would be possible to achieve the same results with only one resistor, making it common to both cathodes. As a matter of fact, our original set was wired like this and performed well enough, except for a tendency to instability on the last few degrees of volume control rotation. Normally this much gain would not be needed for local reception, but it did prevent the set being used "flat out."

CATHODE COUPLING

The trouble was finally traced to coupling between the 6AR7 and the ECH35, due to the common cathode resistor and by-pass condenser.

Briefly, the story of this instability is this: The cathode current of the 6AR7 contains IF signal components which have been considerably amplified and these are flowing through the cathode resistor, which is also between the ECH35 cathode resistor and chassis. This network is by-passed with a condenser, however, the purpose of which is to present such a low impedance path at the IF, so that no appreciable signal voltage will be developed across the resistor at this frequency.

If the condenser is not large enough—that is, if the impedance is not low enough—IF signals voltages will be developed, and they will be applied between the chassis and cathode of the ECH35. Since the grid of this valve is also returned to chassis, the signals are effectively applied between the grid and cathode, the result being feedback (or regeneration, as we have called it elsewhere).

In the past designs, we have made deliberate use of regeneration to achieve adequate gain and it has been necessary to have a special adjustment to control it. In this set there is plenty of gain without regeneration and we are therefore avoiding its effects—both deliberate and accidental. As a result, our set becomes simpler to handle and there is no worry about the thing squealing if the knobs aren't correctly set.

In our case it was possible to cure the trouble by increasing the size of the by-pass condenser, but it had to be made inconveniently large. It was decided that separate resistors and by-pass condensers would not only be more convenient, but also more effective, thus providing a margin of safety which is always desirable in a beginner's set. So in fact it proved to be, the modified version being completely stable, with the volume control fully advanced.

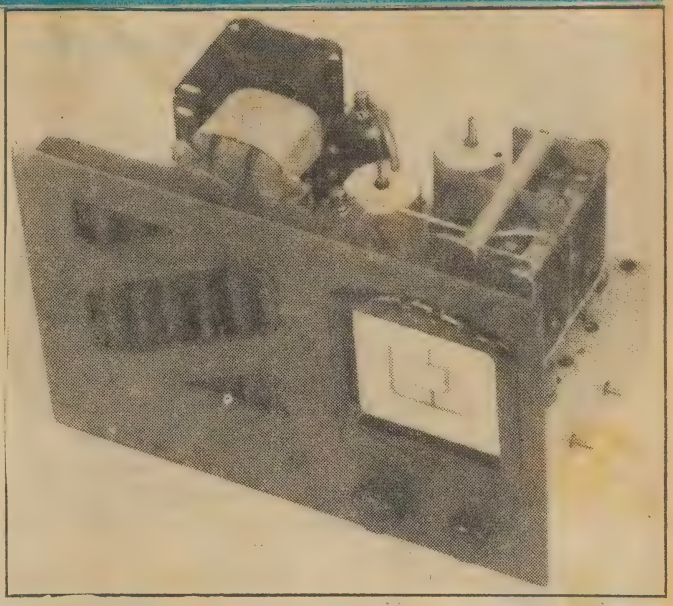
ALTERNATIVE VALVES

If you are unable to obtain the ECH35 valve, there are several which may be substituted for it. The ECH33 is identical except for heater current and may be plugged in without any changes whatever. The 6J8 and the 6A8 may also be used and have similar operating conditions and socket connections. In some cases it may be necessary to shield these valves, although we plugged each of them into the original set and obtained almost identical results.

An optional fitment is a tone control, shown dotted in the circuit, and which can use the same components as were used in the "Reinartz Two," that is, a .1 megohm pot and .02 mfd. condenser. If you do not fit a tone-control you will probably find it necessary to provide a certain amount of fixed top cut. The exact amount will depend on a number of factors, including the type of speaker and your own personal taste, but we suggest a condenser of between .005 and .01 mfd. from the 6V6 plate to the HT line. The larger the valve, the deeper will be the tone.

Now for the actual job of construction—or should we say reconstruction?

FRONT VIEW OF THE RECEIVER



This front view shows the ECH35 just behind the speaker baffle, the IF transformer behind it, and the 6AR7 and the 2nd IF at the rear.

Those of you who have progressed as far as the "Reinartz Two" or the "Reflex Two" will have a lot of preliminary work already done. The power supply, which includes the transformer, rectifier, filter choke and condensers, may be left wired exactly as is. The gang condenser, trimmers and dial mechanism, as well as the speaker and baffle, will also remain untouched.

As well as the extra valve you will need two IF transformers (455kc) and an oscillator coil, plus some minor bits and pieces. We were able to save the price of one coil by using the Reinartz coil as an aerial coil, without, of course, using the feedback winding. In general the "long aerial" terminal will be used, this being equivalent to the coupling provided by a normal aerial coil.

Having obtained the necessary additional parts, strip out the existing wiring, with the exception of the power supply. Now mount the valve sockets and IF transformers, taking care that they have their pins correctly located, as shown on the wiring diagram. At the same time you can mount the tag strips, the volume control and, if required, the tone-control pot.

Before fitting the IF transformers, make sure that the first one has a grid lead from the top of the can. If not, carefully remove the unit from the can and solder a short length of hook-up wire to the grid pin, pass it

PARTS LIST

- 1 "Little General" chassis.
- 1 2 gang condenser. Type H or AWA.
- 1 Dial MK/17A with glass to suit gang.
- 1 Front panel, 10" x 7" or
- 1 "Little General" cabinet.
- 1 Each of 6AR7-GT, ECH35, 6V6-GT, 6X5-GT.
- 1 PF201 power transformer.
- 4 Octal sockets.
- 1 14 henry 60 mA filter choke.
- 1 5" permag. speaker with 5000 ohm transformer.
- 1 Aerial or Reinartz coil.
- 1 Oscillator coil.
- 1 each 1st and 2nd IF transformers (455 Kc).
- 1 .1 megohm potentiometer (tone control, optional).
- 1 10,000 ohm potentiometer.
- 2 300 ohm, 3 watt resistors.
- 1 .05 megohm, ½ watt resistor.
- 3 .05 megohm, 1 watt resistors.
- 1 .25 megohm, ½ watt resistor.
- 1 .5 megohm, ½ watt resistor.
- 1 250 ohm, .3 watt resistor.
- 1 25 mfd 40V electrolytic condenser.
- 2 16 mfd 525V electrolytic condenser.
- 2 .1 mfd 400V paper condensers.
- 2 .1 mfd 200V paper condensers.
- 1 .05 mfd 400V paper condenser.
- 1 .02 mfd 400V paper condenser (tone control, optional).
- 1 .005 or .01 mfd 400V paper condenser.
- 1 500 pf mica condenser.
- 1 425 pf mica condenser
- 1 50 pf mica condenser
- 2 Trimmer condensers. Knobs, grommets for dial drive and power cord, tag strips, nuts and bolts, terminals, hook-up wire, &c.

IDEAL COMPANIONS

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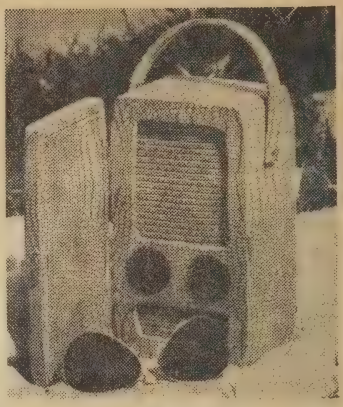


CARRY-SET

Smartest of all small portables. A 4-valver, extra simple to build and most efficient in action. Smartly streamlined cabinet makes it a pleasure to carry, and the size is only 8¼" x 4½" wide x 4" deep. Originally described in "Radio and Hobbies," October, 1949.

HANDY TALKIE PORTABLE

("R. & H." Oct., 1947. and Dec., 1947.) The smallest possible 5-valve portable. Ideal for distance getting, combined with compactness. A 4-valve version also available in the same cabinet. Size 7" x 4½" x 5".

SENIOR PORTABLE

Originally described in "R. & H." for December, 1948, this 5-valve portable with R.F. Stage uses either 6" or 7" speaker. A kit of parts for an A.C. power supply is also available. Cabinet size of portable 12½" x 8½ x 6½".

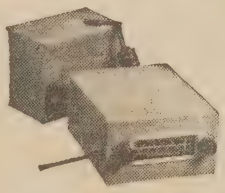
MULTI-TALKIE PORTABLE

("R. & H." July, Aug., 1948.) As its name implies, this is a multi unit portable. It is available as a small 4-valve D.C. portable and in addition, an A.C. power unit can be built to enable it to operate from the A.C. mains or a vibrator unit can be built to enable it to operate from a wet battery. Size of portable cabinet 7" x 4½" x 5¼".

SPRINGTIME PORTABLE

("R. & H." Oct., 1946.) A sturdy 5-valve portable with R.F. Stage which will take any amount of hard work. Cabinet size including hinged lid, 13" x 8⅝" x 5¼".

. . . and for Car and Home



KAR-SET

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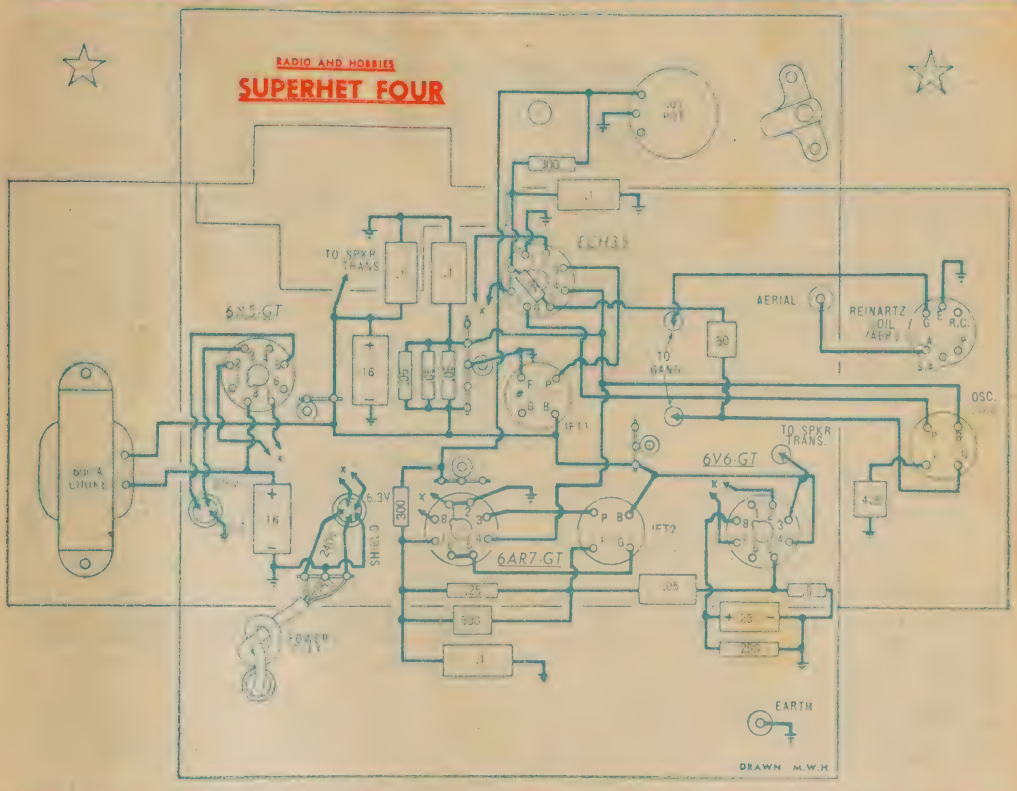
WIRING DIAGRAM OF THE SUPERHET FOUR



This wiring diagram should enable you to lay out the components as we did in the original. With the aid of it and the circuit you should make a first-class job.

through the hole in the top of the can, and reassemble.

As shown in the wiring diagram, the ECH35 mounts at the front of the chassis between the gang and the loudspeaker. The small aluminium plate used to mount the coil in this position is no longer needed. Immediately behind this is the 1st IF transformer and the 6AR7 is alongside the power transformer at the rear of the chassis. The 2nd IF transformer is also at the rear between the 6AR7 and the 6V6, the latter being behind the gang.

There are two coils to be accommodated, the aerial and oscillator coil, and these are mounted under the chassis, beneath the gang, with the aerial coil to the front of the chassis. The exact method of mounting we will discuss a little later.

It is advisable to get as much of the wiring completed as possible before fitting the aerial and oscillator coil and, in particular, that around the 6V6 socket. This corner becomes rather cramped when the coils are fitted. Another job to be done at this stage is to mount the aerial terminal and connect a short length of lead to it, which will eventually go to the aerial coil.

The position of the aerial terminal can effect the stability of the set and if left on the rear of the chassis will be very close to the 6V6 socket. Although most of the RF signal is filtered out of the detector circuit, a small amount will usually find its way into the grid circuit of the 6V6 and will appear in the plate circuit considerably amplified. If this circuit is within coupling distance of the aerial wiring, there is a good chance of unwanted feedback.

AERIAL TERMINAL

We mounted the terminal towards the front of the chassis, actually in one of the holes used for headphone terminals in an early version of this series. This worked very conveniently, giving a run of only a few inches to the aerial coil.

Also in the interests of stability and for much the same reasons as outlined above, it is desirable to keep the plate lead of the 6V6 away from the remainder of the wiring. We found the best way to do this was to take the lead through a hole in the chassis near the socket and along the top of the chassis to the speaker.

The wiring is not particularly difficult, and, with the aid of the circuit and wiring diagram, you should have no trouble in following it. When rewiring the filament circuit, don't forget to retain the earthing of one side. We overlooked this point and there was quite a merry little hum in the output until we tracked it down.

When you have completed as much of the wiring as possible, you can think about mounting the coils. Actually it is advisable to give the matter of mounting some consideration before you buy them, as the type will govern the mounting arrangements you will use. The main difference is the location of the iron core adjusting screw, some coming out of the top and others out of the bottom.

In the case of those with the screws at the bottom it is usually possible to mount them by the assembly screw at the top of the can using a small hole in the side of the chassis. This makes mounting fairly simple and quite firm, the only disadvantage being that the adjusting screws are not quite so accessible.

The other type, having the screws at the top, are not quite so easily dealt with and we found it best to make a small aluminium bracket which would hold the coils by their normal mounting screws, allowing the adjusting screws to protrude through holes drilled in the side of

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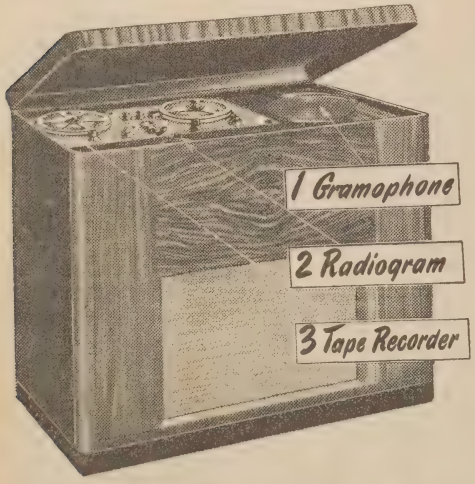

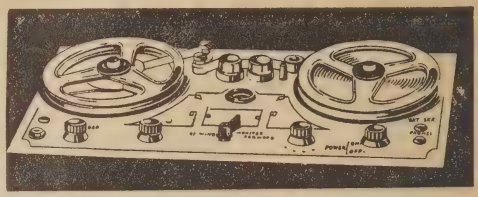

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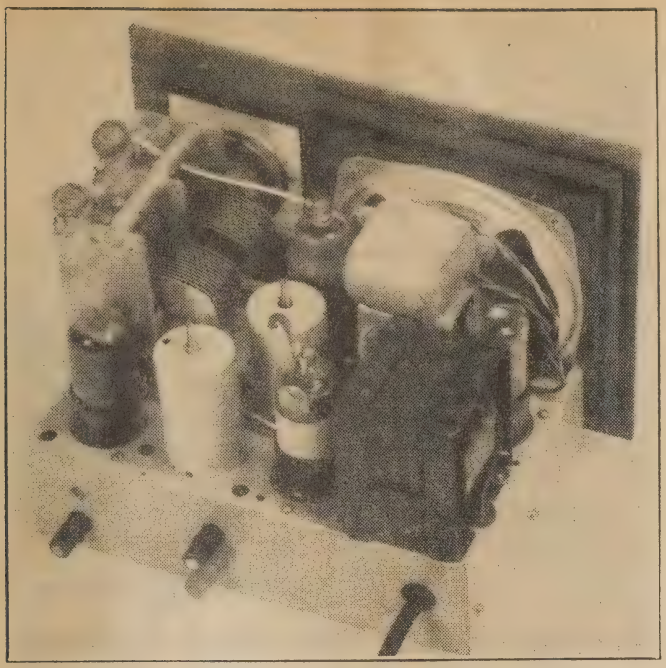

Here the 6V6 may be seen on the extreme left at the rear of the gang. The 2nd IF transformer is to the right of it and the 6AR7 alongside the transformer.

the chassis. This arrangement involves a little more work, but makes a very firm job, as well as placing the adjusting screws where they may be easily reached.

There is one important point to watch with this arrangement, however, and that is the clearance in the cabinet. Most cabinets seem large enough to accommodate these screws without trouble, but it is important to get this matter settled before you buy either the cabinet or the coils.

THE COILS

Now it only remains to wire the coils, not forgetting the leads to each section of the gang and that to the grid of the ECH35, the latter being taken from the fixed plate connection at the top of the gang.

With all the wiring completed, give everything a careful check over, making sure that there are no blobs of solder or silly wiring mistakes, and then switch on. If your wiring is correct, you should get stations straight away, but the performance of the set will depend on how correctly the various tuned circuits are adjusted.

Most coils are roughly set when they leave the makers, but it is unlikely that they will be "right on the nose" and, even if they were, the additional wiring of the set would upset such adjustments. All this means that before you can get the best out of this set it will have to be aligned and by far the best way to do this is with the aid of an oscillator or signal generator.

If you know someone with such an instrument you may be able to prevail upon him to lend it to you, or, better still perhaps, do the job for you. Alternatively, you may care to take the set to a professional serviceman who will do the job for a small charge.

However, these services may not always be readily available, or you may want to tackle the job yourself, anyway, just for the experience. If so, it should be possible for you to do a reasonable job, providing you take things in their correct order and proceed carefully.

When a generator is available it is usual to align the IF transformers first, but when using stations only as a source of signal it is best to take this on trust, for the time being at least, and proceed with the trimmer and core adjustments. Before actually commencing the alignment make sure that the dial pointer corresponds with each end of the dial or overlaps equally at both extremes of its movement.

When judging the level of a signal, it is best to keep the volume at a minimum, as under these conditions the ear is much more sensitive to changes and a more accurate job will result. Use only a short aerial for preference.

First tune in a station at the low frequency end of the band, somewhere around 600kc, and note its position relative to the calibration markings. (It is assumed that you have a calibrated dial glass and that it is matched to your gang.) The adjustment of the oscillator coil slug governs the position of stations at this end of the band and if it has been correctly set at the factory the calibration should be very close.

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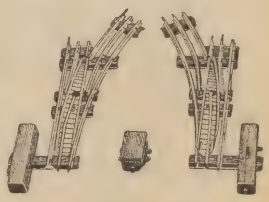

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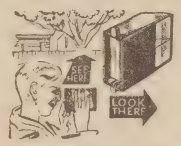

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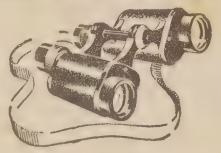

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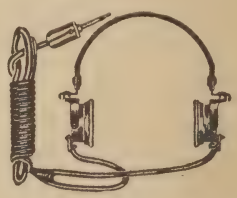

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Unless there is considerable discrepancy it is best not to disturb the oscillator coil setting, but simply adjust the aerial coil slug for maximum volume. Now loosen the screws holding the pointer disc and move it on the gang shaft until the pointer corresponds with the appropriate dial markings. After you tighten the screws check to make sure your setting is still correct.

THE TRIMMERS

Next tune in a signal at the high frequency end and note its position with reference to the appropriate calibration mark. If it is off calibration it should be corrected by adjustment of the oscillator trimmer, screwing the trimmer out (less capacity) if the station is found higher in frequency than its marking and screwing it in if lower. When the calibration is correct the aerial trimmer should be adjusted for maximum volume.

The above adjustments should be fairly accurate if we can assume that the IF transformers were correctly set, or nearly so, but results can be improved still further if these can all be set to the same frequency, even though it may not be exactly the right one.

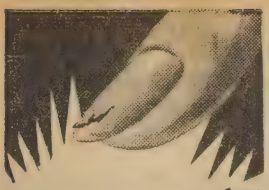
Carefully tune in a station and reduce the volume as before. Now note the setting of each IF adjustment before you touch it and then give it a turn or so carefully in either direction and note results. Normally a great amount of movement should not be necessary, at least to give you an indication of any change, and once it is evident which way the adjustment needs to be made you can proceed until a peak is reached. Usually only a slight "touch up" will be required, but it can make quite a difference to the overall performance.

If you should have access to a generator it is usual to align the IF transformers first, adjusting them to the now standard frequency of 455 Kc. To do this set the generator to 455 Kc, disconnect the aerial from the set and connect the output leads from the generator to the grid of the ECH35 and the chassis. The gang is normally set full open.

Turn the receiver volume control full on and then increase the output from the generator until a signal is heard at a low level. If an output meter is available this should be connected between the plate of the 6V6 and chassis. Adjust each of the cores until maximum output is either heard or indicated on the output meter.

You may now connect the generator to the aerial and earth terminals and adjust the coils and trimmers exactly as if you were working from broadcast stations, except that you now have the benefit of a steady signal and can set the generator to the most desirable frequencies. These are 600 Kc for the coil slug adjustments and 1400 Kc for the trimmers.

And that is about all there is to tell about the set, except to say that, wired and adjusted correctly, it should out-perform any of the previous sets in this series. You should no longer have to worry unduly about your location, or prune your aerial to a critical length. The set is no longer an experimental toy, but a full-sized mantel set in its own right, so collect the few extra bits and pieces and go to it—you'll have a set you can be really proud of.



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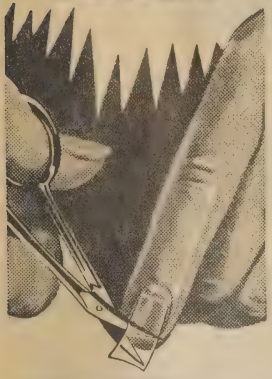

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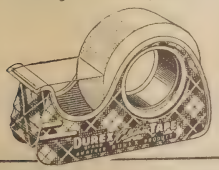

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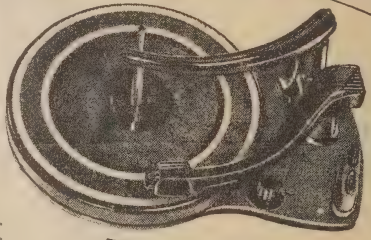

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FROM THE SERVICEMAN WHO TELLS

To date I have discussed the main pieces of test equipment you will need to set up a service shop. This is by no means all, but it is a good basis on which to start. I have therefore decided to leave aside actual equipment for the next couple of articles and deal with the workshop itself — its requirements, type of bench, fittings, etc.

TOO much stress cannot be laid on the need for a well-laid out workroom and properly designed benches. The old saying about "a place for everything and everything in its place" applies as well to radio servicing as it does to anything else, and probably more so in many cases for there are more "things" to be misplaced.

There is probably nothing more exasperating than not being able to find the tool or component you want, particularly if you happen to be in the middle of a sticky job, while the waste of time, as represented by £sd can be a very serious loss if allowed to continue.

HAPPENS TO ALL

Of course it happens to all of us now and again, including yours truly, which is just why I am writing about it. However, every effort should be made to keep it to a minimum and the fellow who is forever scratching through a pile of gear in a vain search for something which he "knows he has somewhere" is doomed to failure.

What then do we need in the way of fittings and layout for our workshop? The first and most obvious item is the bench itself, but I will leave the finer details of this for the time being, merely accepting the fact that a certain amount of space must be left aside for it.

In this regard it is well to remember that you may not always be a one-man show and when the time comes for you to enlist some help, you will need extra bench space. Even when you start, you will often find that you need to have two or three chassis on the bench at the one time, some under observation for intermittents, others waiting on components, &c.

This means that you should have, if possible, at least twelve feet of bench space and something like this amount may usually be fitted along the full length of one wall. However, before deciding on the position, it is as well to take into account such factors as natural lighting, making the best use of the available space, and whether you want the bench to be visible from the shop. I will have more to say on this point a little further on.

A SET RACK

A rack to hold sets while awaiting either to be serviced or returned to their owners is absolutely essential, and there is nothing more deplorable than the habit of allowing sets to decorate the floor and form a kind of maze through which one has to pick one's way every time the journey is made from the work bench to the counter.

Sooner or later, of course, the inevitable is bound to happen — you'll put your foot through the dial glass or some other vital part of an expensive set.

A simple rack may be made largely from 3 x 1 softwood and the shelves need be nothing more than strips placed several inches apart. The actual size and shape will depend on the available space, but it should be as commodious as possible.

Some fellows like the idea of two racks, one for incoming and the other for outgoing sets but while this approach to system is commendable, it seldom works so well in practice. The trouble is that one generally has a surplus of sets in one classification or the other, with the result that the outgoing rack has to accommodate some of the incoming sets or vice-versa, and away goes your system.

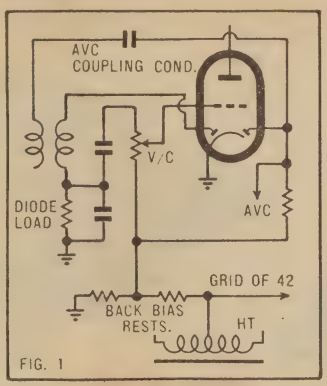

FIG. 1

The original circuit was something along these lines. There is no voltage between the diodes and cathode because both are returned to the same chassis. Bias is supplied to the grid from the network between transformer centre tap and chassis.

A better scheme seems to be to simply keep one end of the rack for "in" and the other end for "out" (or the top and bottom if it is of upright construction). If the sets are stacked as far as possible toward their appropriate ends of the rack, the line of demarkation should not be difficult to maintain.

Incidentally all sets on the rack should carry some identification tag, for, with more than three or four sets in the place it is all too easy to forget what belongs to who, and it does not create a good impression to have to ask a customer into the workshop to identify his own chassis.

It is also unwise to trust to your memory for all the details and symptoms of the set's defects, and these should be written on a service card which can accompany the set right through the shop, eventually recording the work done and the price to be charged. Records of this kind are particularly important when you may have to leave the shop in charge of someone else for short periods.

As well as the service bench there should also be a heavy duty bench, equipped with a substantial vice and carrying your selection of metal working tools. It is often necessary to carry out minor repairs to the metal work of sets, particularly old ones, or to make clamps or plates to modify them for modern replacement components. On a bench remote from the service position you can bash away to your heart's content without fear that the vibration will damage delicate meter movements or valve elements.

In the same general area you can well set aside a section for the cleaning down of chassis before being put on the "in" rack. It is seldom indeed that you will get a chassis which does not need some cleaning, and most of them, to put it bluntly, are filthy.

A CLEAN UP

Not only is it most unpleasant to work on a set in this condition, but it is very bad policy to return a set to a customer without a general clean-up. The fact is that the customer is unable to appreciate the real work that has been done on a set and he will, unconsciously perhaps, tend to judge the job from the appearance of the set. Illogical? Well maybe it is, but there is not much you can do to alter it, so you might just as well turn it to your own advantage.

Factories usually use compressed air for cleaning and you can try using the blower on a vacuum cleaner if you like, but the objection to such a system is that it merely removes the dust from the chassis and allows it to settle on everything else in the room. The use of suction is not normally possible because of the irregular shape of the chassis and components.

The method I personally favor is the not-too-vigorous use of a medium sized paint brush, say about two inches wide. This will go readily into odd corners and if you work carefully you can coax most of the dust into a suitable container (dust pan to you) without depositing an undue amount around the room.

POWER POINTS

Before going very far in planning the layout of your workshop you will have to consider the matter of power points. You will need quite a number of these, for there are the various pieces of test equipment (not

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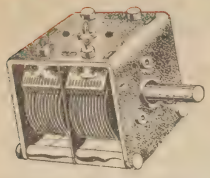

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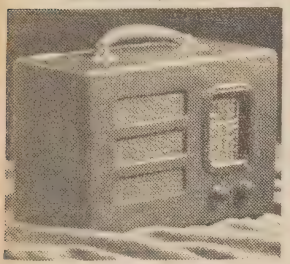

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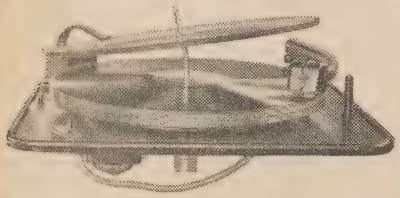

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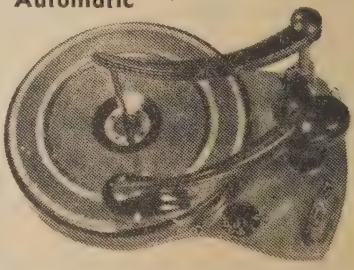

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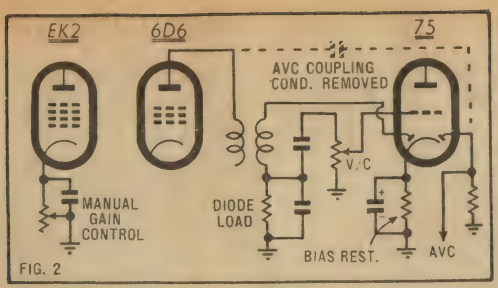

FIG. 2

As the set was modified. The generation of bias in the cathode circuit also biased the detector diode. To reduce distortion the AVC coupling condenser had been removed and a manual gain control fitted.

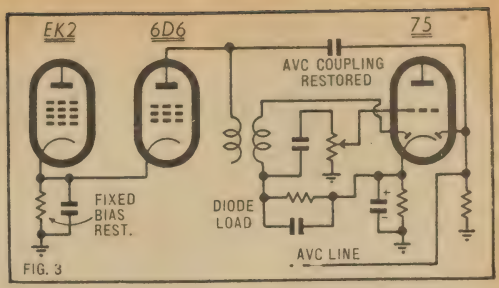

FIG. 3

Returning the diode load to the cathode removed the unwanted voltage and produced normal sensitivity and quality. This allowed the AVC circuit to be restored and fixed bias was substituted for the manual gain control.

forgetting possible future additions) a soldering iron and perhaps some other power operated tools at a later date, and whatever sets you have running on the bench.

In addition to having a sufficient number of outlets for every piece of equipment it is very convenient to have extra outlets which will permit a choice of operating positions on a large bench. For example you may require to place an intermittent set under observation and attach to it as many pieces of test gear as you can spare. At the same time you will require sufficient bench space and outlets to allow you to continue with more orthodox repairs.

As well as the conventional type of outlet you will need to make provision for all the odd types of old-fashioned fittings such as two-pin round, two-pin flat, three-pin round (in a number of different styles) and, of course, the inevitable bayonet adaptor. Removing these fittings, keeping track of them, and then refitting them, can waste a lot of valuable time, and it is really essential that you have sockets to suit.

This brings us to the whole question of how your requirements are going to fit in with regulations of the local supply authorities. In the first place, there is a definite limit to the number of outlets which are permitted on a single run from the fuse-box and this may vary from six to 15, according to local regulations.

MINIMISE RISK

The idea behind this, as far as the authorities are concerned, is simply to minimise the risk if too many appliances be used at the one time, with consequent overloading of the circuit. Unfortunately, it does not take into account the wide difference in the current consumption of various appliances, and it is quite easy to have all outlets in use and be nowhere near the rating of the line, or yet to overload the circuit with only two or three heavy-duty appliances.

To add further to what is a somewhat confused situation, most authorities countenance the use of two-way or multiple adaptors with the proviso that the onus is on the user not to overload the circuit.

A serviceman's requirements are for a large number of outlets, each of which will be required to carry only a very light load, seldom more than 50 or 60 watts. While it is unlikely that they will all be in operation at the one time, the large number provides convenience of position, rather than anything else.

All things considered, the best approach would seem to be the provision of as many regular outlets as is practicable, and into which can be plugged multiple outlet blocks located at strategic points on the bench.

The same scheme can be used to provide the non-standard outlets already mentioned although, strictly speaking, the legality of using these fittings may be in some doubt. Very often the authorities accept such fittings in old buildings until such time as the system has to be rewired, but they insist on standard fittings in all new installations. Thus a fitting which may be legal in a customer's home may be illegal in your workshop, and this applies particularly to two-pin systems without a protective earth circuit.

However, providing such outlets are used merely to test sets having these fittings and not as a regular power outlet, it is unlikely that there would be any objection to their use.

Outlets for soldering irons and power-operated tools are best located under the front of the bench, usually at the top of the legs. This is better than working from an outlet above the bench, when the lead will be draped across your work and is just one more distraction and inconvenience.

A good safety measure is to have the power circuit fitted with a small circuit-breaker, conveniently located and set to blow at slightly less than the main fuse. This provides a two-fold convenience. First, in the event of a momentary short-circuit, the circuit-breaker will trip before the main fuse blows and it is only a moment's work to reset the breaker and thus save all the bother and time required to repair a fuse.

Secondly, when a power-transformer starts to emit smoke and sparks, or someone gets caught on a "hot" wire, precious seconds can be saved by opening the circuit-breaker.

FLUORESCENT STRIPS

Adequate lighting is most important, and it is as well not to stint matters in this regard. Many chassis are hard enough to work on under ideal lighting conditions, and a lot of valuable time can be wasted if you can't see properly into the "innards" of a compact design.

For general illumination, fluorescent strips produce excellent results, and when mounted above the bench, the diffused nature of the light approaches that of shadowless illumination. The main objection to some of these lights is their creation of radio interference and the relatively short life of the tubes, at least in the popular hot cathode type.

Another approach is to use a fitting similar to the fluorescent type and fitted with a diffusing glass behind which may be located several filament type lamps. This will retain the effect of the light falling on the work from several different directions, reducing glare and minimising shadows.

Even with the best overhead lighting there sometimes arises the need for a little extra to get into the corner of an awkward chassis, and an adjustable bench light is a handy addition. However, the use of such a fitting only as the main source of light, with poor general room light, is unwise as it leads to severe eye-strain.

Should you unveil your workshop to the gaze of your customers, or should it be completely hidden?

There is much to be said both ways on this matter. The idea of revealing your workshop is, of course, to impress the customer with the efficiency and completeness of your layout, or, in other words, your ability to do a good job. The fact that he has little or no knowledge of the instruments on show is no disadvantage; in fact, just the opposite!

On the other hand, even the most tidy of us will find it impossible to keep our bench forever looking like a model display, and a certain amount of organised disorder is inevitable.

GLASS PARTITION

One suggestion is a glass partition behind the main counter and providing a restricted view of the workshop. By carefully arranging the height the customers' gaze will be directed toward the instruments above the bench, rather than the bench itself, and the whole effect is suggestive of a studio control-room and can be quite impressive.

At the same time it enables you to keep an eye on the shop when by yourself and give privacy of conversation if you have an assistant. It is also quite easy to draw a curtain across the panel if the appearance of the room becomes too disorganised.

So much then for that subject.

Surveying the disorganisation of my own bench I realise that it is time I gave it a birthday, but, first, I have to write my prize case of the month.

For this I can think of nothi

(Continued on Page 53)

The new cabinet measures approximately 10in wide x 10in high by 6in deep. Ventilation slots are included in the rear lids to prevent overheating on mains operation.

We've described portable sets before but never one with all the features of this new set. Out of doors, it is a powerful, sensitive battery set, operating from the new composite battery pack. Indoors, you simply pull out the power flex and plug it into the mains.

THE JUBILEE PORTABLE SET

by W. N. Williams

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Everything mounts on the one simple chassis and everything is immediately accessible for checking and servicing.

The in-built loop, attached to the back lid picks up all the signal you want from the local stations, either on mains or battery operation. Out in the country, if you want more signal pickup, you can sling a length of wire over a nearby bush, push a spike into the ground for an earth and hear every signal worth listening to.

In the matter of logging stations, the set is on a par with our "Senior Portable," which we took for a 2000-mile ride to test its performance. With the same RF stage, the same valves and coils and the same operating voltages, the RF performance should be identical. We have no worries on that score.

Our attention was focused rather on the matter of alternative AC operation, which we regard as extremely important.

Portable sets have their attractions but they are rather profitless in the off-season, when one might hesitate to buy new batteries for an odd occasion. And even if new batteries are installed, it becomes expensive to use the set around the house and workshop with the same abandon as a regular AC mantel job.

We've already said as much before and described units which have attached to the earlier portables to run them from the AC mains. However, we wanted here to avoid the complication of adaptors that had to be added on or plugged in. What we wanted was a completely universal and self-contained receiver.

From a design point of view, there are two possible lines of approach. Of course, you have to use battery valves and, in the first case, the filaments are wired in the conventional parallel fashion. For battery operation, a suitable 1.5 cell is required while, on AC, an elaborate metal rectifier and filter system delivers the appropriate DC voltage.

USE OF BATTERY

Unfortunately, it is necessary to use the original A-battery to help stabilise and filter the output from the rectifier, otherwise the set hums incurably. The switching has to be very carefully thought out, also, to prevent damage to the A-battery by subjecting it either to an excessive charge or discharge.

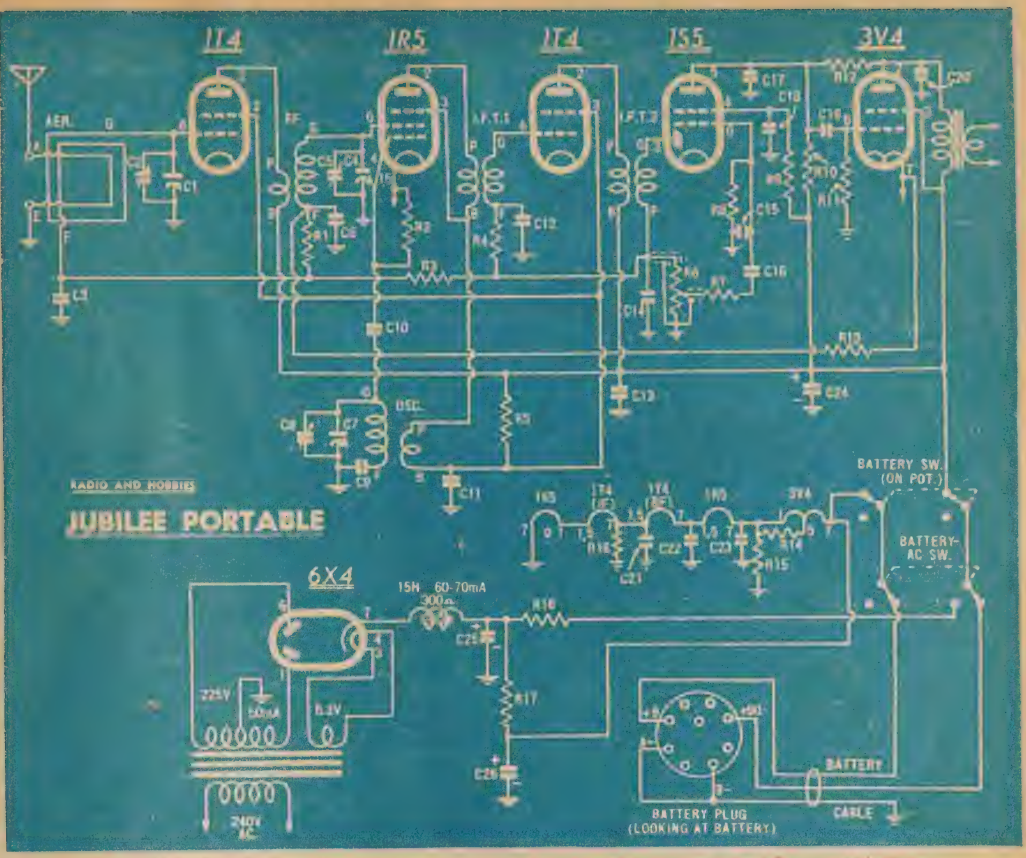
The alternative approach, as used in our earlier "Universal Portable" is to wire the filaments permanently in series so that they require, typically, 9-volts at 50 milliamps. This amount of current can be readily handled by an ordinary rectifier and filter system and there is no need to rely on batteries to stabilise and filter the supply.

There are other minor considerations. The parallel connection is the easier to wire and test but the series connection offers "free" grid bias voltages by reason of the different filament potentials.

Without laboring the point further, the tendency now is to favor the series connection and, in line with this trend, battery manufacturers have released a composite A and B-battery pack which delivers either 7½ or 9 volts for the filament circuit and 90 volts for the HT supply. The sizes of the cells are worked out so that they will have the same approximate life on the assumption of a 50-milliamp filament drain and a HT drain of about 13 milliamps.

Connection to the battery is by means of a single 8-pin plug, which eliminates the chances of wrong connection. The conclusion, it would seem, is foregone.

Turning to the circuit, the sequence of stages is conventional—RF, converter, IF, detector and audio finally



The complete circuit diagram. The battery section may be built first, if desired and the AC supply added later.

the output valve. Grid, plate and screen connections are all conventional for a set of this type and call for little comment. The filament and AVC network, however, does warrant some explanation.

The basic filament network is shown separately, with pin numbers marked. Counting the 3V4 as a 3-volt tube, the filament string requires 9-volts at a nominal 50 milliamps.

RETURN CURRENT

In actual operation, the plate current of valves near the positive end of the string flows through the heaters closer to the earthed end so that, if no allowance were made, the 1S5, for example, would be carrying the initial 50 milliamps from the A-battery plus some 12 or 13 milliamps of HT return current.

While full correction would ideally call for a compensating resistor across each separate filament, we have found it sufficient to add three resistors only, namely R14, R15 and R18. These disperse the additional current due to the 3V4 and allow the remaining filaments to operate with reasonable potentials.

Three bypass condensers are also shown along the string, their purpose being to minimise interstage coupling at both RF and audio frequencies.

As previously mentioned, the series filament connection has an immediate bearing on the operating bias of the stages, since the heaters become progressively more positive in respect to earth. Thus the 3V4 is connected at the positive end of the string, its grid being returned to earth. This makes the filament approximately 5.6 volts positive with respect to grid, which is the same

PARTS LIST

1 Chassis 9¼in x 5in x 1¼in.
1 Small three-gang (AWA or similar).
1 Dial type MSL-48 with glass to suit gang.
2 Broadcast coils (RF & Osc to suit 1R5).
1 Loop aerial.
2 455Kc IF transformers. (No. 1 and No. 2.)
6 7-pin miniature valve sockets.
1 5in Permag. speaker to suit 3V4.
1 90V & 9V battery with 8-pin plug to suit.

VALVES:

2 1T4, 1 1R5, 1 1S5, 1 3V4, 6x4.

CONDENSERS:

C1, C4, C7 Gang sections.
C2, C5, C8 Gang trimmers.
C3, C6, .05mfd 200V Paper.
C9, 425pf 2½% mica.
C10, C14, 100pf midgef ceramic.
C15, C17, 50pf midget ceramic.
C11, C13, .1 mfd 200V paper.
C12, C18, .01 mfd midget ceramic.
C16, C19, .005 mfd mica.
C20 .001 mfd mica.
C21, C22, .1 mfd tubular 200V.
C23, 25 mfd, 40V electrolytic.
C24, 8 mfd, 150V or higher electrolytic.
C25, 24 mfd, 350V or higher electrolytic.
C26, 500 mfd, 12V electrolytic.

RESISTORS:

R1, R3, 1 megohm ½ watt.
R2, .1 megohm ½ watt.
R4, 3 megohm ½ watt.
R5, 5000 ohm 1 watt.
R6, 1 meg potentiometer with D.P. switch.
R7, 50,000 ohm ½ watt.
R8, R12, 10 megohm, ½ watt.
R9, R11, R13, 3 megohm ½ watt.
R10, 1 megohm ½ watt.
R14, R18, 400 ohms ½ watt.
R15, 1000 ohms ½ watt.
R16, 2500 ohm 2W (or two 5000 1W in parallel).
R17, 3000 ohm 20 W.

SUNDRIES:

2 pin jacks, approx. 18in shielded wire, hookup wire for battery leads and for wiring, three knobs, solder lugs, nuts & bolts, &c.

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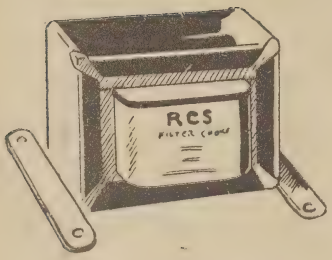

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TC65 50 M/A 30 Henries 400 Ohms D.C. Res.

TC66 60 M/A 14 Henries.

TC80 150 M/A 30 Henries.

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thing as applying 5.6 volts of negative grid bias.

Complication arises in regard to the AVC circuit, which requires a common return path for the 1S5 diode and the three controlled grids. A simple AVC network is out of the question, because it would not maintain each grid initially at zero bias with respect to its own filament.

The problem is overcome by arranging the AVC line so that the diode and each of the controlled grids is tapped along a high resistance divider which steps the potential up at each feed point in the same ratio as the steps in the filament network. Thus, with no signal input, the diode and each valve grid assumes a potential equal to the potential at its own negative filament pin — in other words, zero bias.

AVC ACTION

With an input signal, the diode generates an AVC voltage which is relayed to the controlled grids. There is some division of the AVC voltage, but ample control is retained to avoid overloading. But, whether or not you understand the foregoing, be most careful to wire the filaments exactly as shown. It will be apparent that many factors have operated to determine the exact sequence of connections.

For battery operation, the filament and HT lines are brought through the double-pole "off-on" switch on the volume control and thence to the "Battery/AC" switch at the rear of the chassis. Three leads run from this to the battery plug.

The leads from the AC supply, on the other hand, follow a different courses. The HT lead runs through both switches so that the volume control has to be turned forward to apply voltage to the HT line. The action of turning the rear switch "battery" automatically disconnects the AC filter components and prevents leakage back through this portion of the circuit.

FILAMENT CIRCUIT

The mains filament supply bypasses both switches and runs direct to the filament line. This protects the low voltage filament bypass from accidental overload.

As it is, nothing drastic can happen with any combination of switch settings, with power on or power off. The worst you can do is to plug the set into the mains and fail to switch it to "AC." In this case, it will play quite happily while drawing its filament power from the mains and its HT supply from the battery.

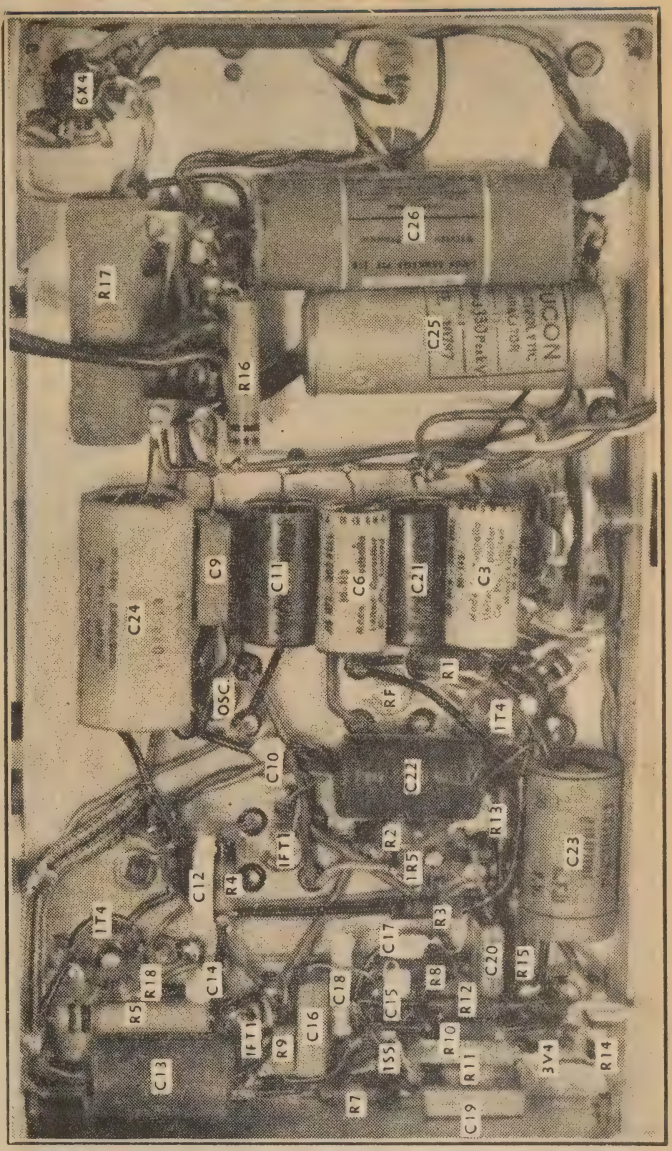
The simple rule, therefore, is to set the switch for "AC" each time you lift the lid and fish out the power cord. In the normal way when the set is used for a long spell in the home the rear switch need never be moved from its "AC" position. In fact, as we said earlier, you can disconnect the battery altogether quite easily or throw it way when worn out. The set runs just the same on AC irrespective of the battery.

The components specified for the AC supply must be duplicated exactly if the voltages are to work out according to plan. The choke used in the original was a 14-henry 60-milliamp type, having a DC resistance of 300 ohms. Other brands of chokes might conceivably have a somewhat higher resistance than this which will tend to lower the operating voltages.

The 300-ohm choke is to be preferred, because its lower DC resistance will avoid an undue heat rise under the full load conditions to which it is subjected. The original choke was a Ferguson C15/60 type, but any other choke with the same current, inductance and resistance ratings will do equally well.

If you have to use a choke with higher resistance it will be necessary to decrease the value of R17, possibly to as low as 2000 ohms. The filament line should have about 8.0

UNDERCHASSIS LAYOUT OF PORTABLE



This photograph shows the position of all the wiring components. Provided small components are used, the original layout can be duplicated without difficulty. Watch the polarity of the electrolytic condensers.

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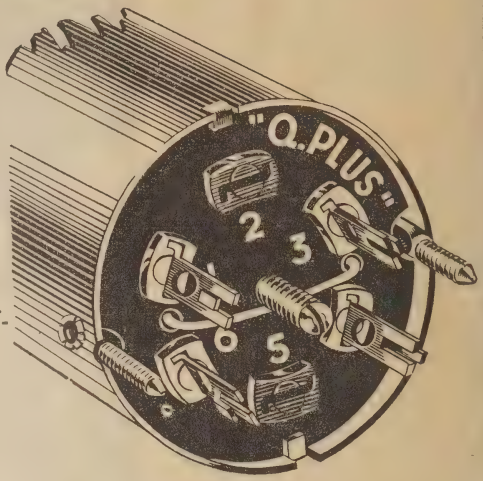

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For years now you have been asked to accept a wire pin as a base but for no longer, as this silver plated terminal anchor will accommodate 3 or 4 pigtails without worry—keep your iron on as long as you like—its definitely thermo setting plastic—Mount your coils first and you can still see the numbers.

Not of such importance but the midget brother has new terminal pins too. These have a groove inside and out around which you can twist your lead—and around which we too are twisting our leads, as unfortunately one or two inside wires have appeared to leave the pin when heat was applied to the outside.

YOU TOO CAN HELP—let us know if there are any ways in which we can improve our product—if your suggestion is adopted YOU WILL RECEIVE A CHEQUE, its value depending upon the degree of improvement adopted.

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applied when the mains are at 240 volts AC. The 50 ma transformer rating is quite in order, by the way, because a choke-input filter is used.

Now for some information on the constructional side.

Detailed chassis blueprints have been supplied to the manufacturers so that, by the time you read this, they should be well on the way to the supply houses. On the other hand, if you can obtain a piece of 16 or 18 gauge aluminium, measuring 12" x 7½", a chassis can be made up by hand without too much difficulty. A blueprint is available for this purpose for 3/6.

Having obtained the chassis, the first job is to mount the major components, beginning first with the tuning gang and dial.

We selected the small AWA gang, mainly because it is in somewhat better supply than other smaller types.

MODIFY BRACKETS

Before mounting the AWA gang, trim 5/16" off the spindle and clean up the end with a fine file. You will also need to modify the brackets to let the gang rest close to the chassis. We drilled new holes in the brackets 15/32" below the original holes and deepened the slot in the brackets with a round file. When mounted, the gang spindle centre should be about 1 5/8" above the chassis.

The dial can also be fitted at this stage, since there is not much danger of breaking the glass. Release the screw which locks the drum to the face plate and, without tangling the cord, slip the drum on to the gang spindle and hold the dial in position. Bolt it in place, making use of the slotted holes to bring the outer surface of the dial flush with the chassis front.

Finally, lock the drum to the spindle, making sure that it has equal travel at both extremes. The bottom end of the pointer wire may also need to be tilted up slightly to clear the gang mounting brackets. It is best to get this part of the set operating properly first, as it is much more difficult after the other components have been added.

Next job is to mount the valve sockets and care should be taken to see that the pins are made to face the right way. Not only will this ensure short leads but it will allow you to duplicate the placement of the smaller components, as shown in the underneath photograph.

SOCKET POSITIONS

The set could be wired in other ways, of course, but you may find yourself left with a handful of parts and nowhere to put them if the layout is varied too much.

Looking over the rear edge of the chassis, mount the 1T4 RF socket with the filament pins to the rear left and put a solder lug under the front nut. The 1R5 socket faces the same way but needs a lug under the rear nut. The same remarks apply to the 1T4 IF socket.

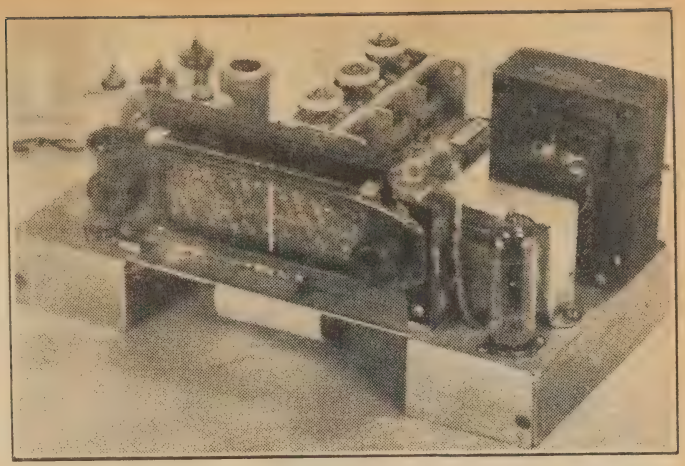
Coming to the 1S5, locate the filament pins to the rear and put a lug under the rear nut. The filament pins of the 3V4 face forward, no lugs being used. This makes rather dull reading but it will save you time and worry.

Next mount the RF coil, placing the grid and AVC lugs nearest the front of the chassis. In the oscillator coil, the grid and padder connections face forward.

1FT1 also faces the same way—grid and AVC to the front—but place a large lug under the locking nut pointing to the right. With transformers using side-mounting lugs, the earth point could be placed at the right or rear.

1FT1 faces the same way — with diode and AVC pins to the end of the chassis, a lug being placed also under the locking nut and pointed towards the end.

The AC power supply components can be mounted next, the transformer being positioned so that the thicker filament wires pass down through the rear hole. Instal a solder lug beneath the rear left mounting nut and also under the nut on the opposite corner. The choke goes in place next, together with the rectifier socket.



The new portable seen from the front. Your commercial chassis will have a larger slot under the dial and large holes near the rectifier to carry away the heat from the AC power supply.

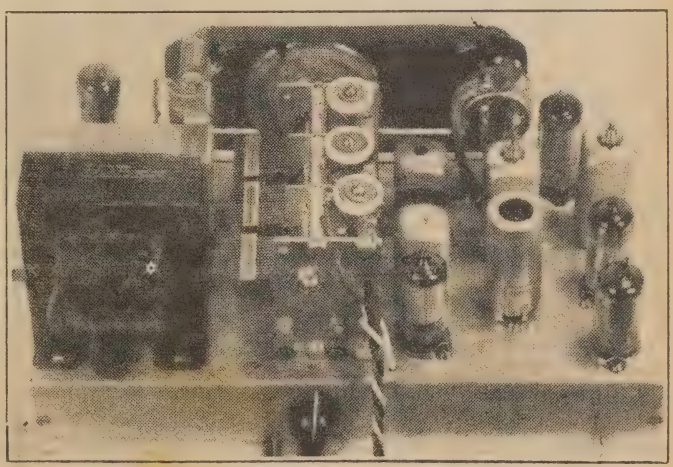
The final assembly operation will be to make up a small angle bracket from aluminium scrap which carries the "battery/AC" switch. It is locked under the two 5BA screws which hold the gang. Lock the switch very firmly in place to prevent it working loose and trim off the spindle so that it is just long enough to take a small pointed knob resting flush against the chassis.

You can now get on with the wiring.

EARTH WIRING

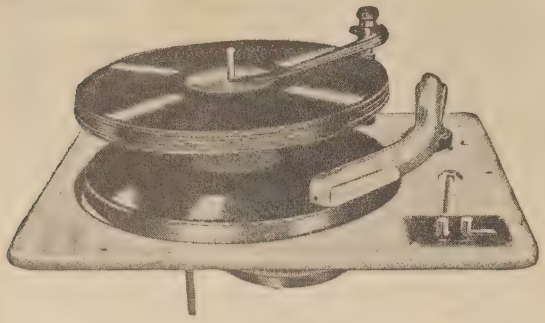
The first job is to earth the centre spigot in each of the sockets to the nearest earth lug and then to run a lead around all of the lugs, in case one of them should happen to develop a bad earth contact. Bare 20 or 22 gauge tinned copper is the most convenient wire to use for this purpose.

The earth wiring to do with the



Note the trimmers attached to the top of the gang. The aerial trimmer could be turned on its side to permit peaking after the set is in position. The loop may be screwed to the rear lid or bracketed to the chassis, whichever you like.

two of the best . . .



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EI/2655

gang condenser warrants special mention, because it forms the earth return and support medium for a whole group of condensers.

We used a length of 18-gauge tinned copper which was shaped so that it ran past the two holes under the gang rotors and turned at right angles to solder to the lugs near the 1T4 RF socket at the rear and under the front right gang-mounting screw.

Additional short lengths of bus-bar were then soldered to this wire and passed up through the chassis to connect to the brass wipers touching the gang rotor plates. The result is a rigid earth network which can be used later as an anchor point for several bypass condensers.

Tackle the filament network next and here you must be particularly careful. It has been drawn separately on the circuit diagram for the sake of clarity. Where pins 1 and 5 are shown as connecting to one end of the filament, the wire may be soldered to either one, whichever is the most convenient. There is no need to solder them together, as they are interconnected inside the valve.

"SPARE" LUGS

Be careful, however, not to use the remaining lug as an anchor point to some other portion of the wiring, or something drastic may happen.

Some of these miniature valves do have spare pins but never connect any wires to the lug unless it is clearly marked in the valve books as "no connection."

Another worthwhile precaution is to use a distinctive color for the different portions of the wiring. It avoids confusion and simplifies checking at a later date. We used grey for the entire filament circuit, red for the HT wiring and plate leads, orange for the screens and oscillator anode circuit, blue for the grids and diode and black for a few other odd leads.

You will be able to put in most of these plate, grid and screen leads before adding the wiring parts. We ran most of them direct from point to point, an orderly appearance being preserved, however, by keeping the small parts "on the square."

The IF transformer and coils we used in the original set had small eyelets only for the connection of leads and these are inadequate where more than two connections have to be made to the same point. We accordingly adopted the subterfuge of sweating about ½" of tinned copper upright on the eyelet and looping the various leads around this.

SOLDERING TIPS

Whatever method you adopt, be careful to avoid shorting anything to chassis with blobs or whiskers of solder around these necessarily small lugs. On more than one occasion we held the set upside down to complete a joint, the idea being to prevent the soldering forming a large blob down close to the chassis.

The upside-down technique is also handy to prevent too much solder clinging to valve socket lugs.

Needless to say, the iron tip must be kept scrupulously clean and well tinned at all times. Wires should preferably be trimmed to length and tinned before being put into position only the merest touch of the iron then being necessary to complete the joint.

Care and speed is essential when using the now-common plastic hook-up wire, as too much heat makes the covering peel back and run. Trim off about 1/8" of insulation with a sharp knife blade, apply the merest touch of flux and quickly tin with a hot iron and resin-cored solder.

As shown in the photograph, the AVC and a couple of other bypass components stack down the centre of the chassis and attach to the earth wire already discussed. Most of the other small components fall naturally into place and can be hung directly between the circuit points they normally serve.

A couple of the AVC resistors need to hang between extended leads but, since only ½-watt resistors are used they do not tend to flop about. Have a supply of 1-mil spaghetti tubing on hand to slip over the resistor and condenser pigtails, before they are soldered into position.

SELECT PARTS

When purchasing the parts, make sure to get the smallest possible components for everything, as this makes all the difference between a set being easy or difficult to wire.

A 2-position tag-strip was locked under one dial mounting bolt to provide an anchor point for the HT line. The 8 mfd condenser swings between this point and the earth line under the gang.

Be careful to sort out the leads passing up to the switch on the rear of the volume control. Check and double-check the operation of the switch with an ohmmeter or with a torch cell and globe. A wrong connection here might easily feed the HT voltage to the filament circuit—with rather drastic results!

From the switch-pot, the leads pass down through the chassis and across to the "battery/AC" which is wired as shown in the circuit. Care is necessary here also, although the operation of the contacts can be observed visually.

Shielded leads are necessary between the "F" terminal on 1FT 2 and the pot and from the pot back to the grid circuit components. With a little care, you can anchor the shielding to the chassis and make the centre lead stiff enough to help support R7.

COLOR CODES

Turning to the power supply end of the chassis, the only likely source of confusion is in sorting out the leads from the power transformer. You may have a color code to assist you but we still had to identify two "black" leads which looked identical externally. You can do it with an ohmmeter but, in case of doubt, get your supplier to sort the leads out for you before taking the transformer away.

We installed a 5-position tag strip to help anchor various points in the power wiring and you could well do the same. Two of the lugs on this same strip also came in handy for the mains lead.

Ultimately the chassis will have quite a few leads hanging from it—three for the battery, two for the speaker, three for the loop aerial and, of course, the twin power cord. There is not much point in providing plugs and sockets for all these leads, because they would represent so much more expense and work to fit them in. The idea, therefore, is to anchor the leads firmly and allow them to run out from under the chassis through slots cut in the shelf.

The leads for the loop—grid, AVC and earth—were threaded through odd holes in the back of the gang and have quite a neat and business-like appearance.

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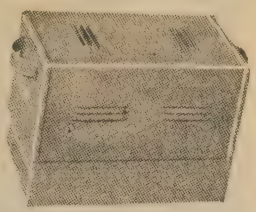
AMPLIFIER CABINETS



These streamlined amplifier foundation units consist of a standard chassis 3" deep with removable top in aluminium. Fitting over the top is a removable cover which has louvres on all sides and handles welded to the ends. Color Grey.

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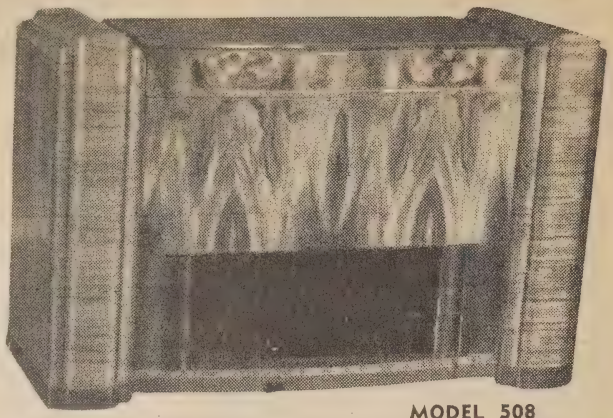

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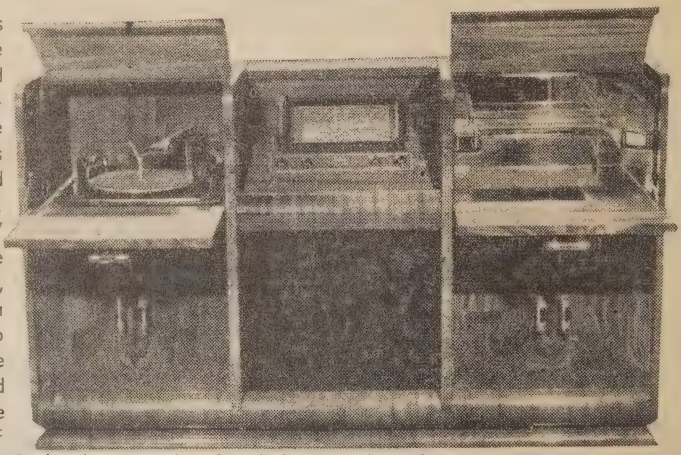
MODEL 508

Model 508 is suitable for all types of record changers.

MODEL 511 is a high grade cocktail and radiogram cabinet suitable for all types of record changers. Made of 1" solid core Italian walnut, finished in a brilliant piano finish. Ample bottle and record space each side of speaker grill.



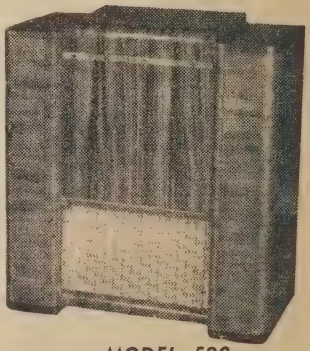
MODEL 511

Cocktail section lined with best quality glass mirrors.

Let Slade's Radio or any of their local dealers show you how cheaply you can convert your old radio into a modern radiogram.

Model 509 is suitable for single motors. Dial fits on front of cabinet, lid being lifted only for record playing.

High fidelity custom built 5 valve D.W. chassis specially built for microgroove or tape recording. Price with 12" Rola speaker £28/10/0 Nett. One Garrard RC65 or RC70A, Collaro or Palliard record changer with each unit.



MODEL 590

SLADE'S RADIO PTY LTD.

LANG STREET, CROYDON, N.S.W.

Tel. UJ5381-UJ5382. **Established 30 years.**

Expert packing for ... out of town deliveries.

The loop can be attached to the rear lid and in a position where it is clear of the chassis. Keep the leads to the set short, to avoid excessive capacitive shunting of the first tuned circuit.

In choosing a loop, it may be best to use one made by the same manufacturers as the coils of your choice. In general, the larger the loop, the better it will be.

The job of fitting the set into the cabinet should not prove difficult and little need be said on this score. It may be wise to regard this as part of the initial construction rather than having to manhandle and fiddle with the chassis after it is adjusted and aligned.

Incidentally, you will need to fit trimmers across each section of the tuning gang and these must not be higher, in the open position, than the top of the transformer, otherwise you may foul the top of the cabinet. Connect the earthed plate to the frame of the gang and make sure that the lugs do not touch the rotor plates when these are in the fully open position.

BATTERY PLUG

One other small worry may be in regard to the battery plug, which might well be on sale by the time you read this. We had to make one, however.

The plug is similar to an 8-pin octal but with an off-centre locating pin rather than a centre spigot. We made one up by cutting the base from an old valve, trimming off the top and drilling out the centre spigot. Inside this base was fitted a bakelite disc carrying a new locating pin and with fine holes drilled above each of the valve pins.

By passing the wires through this disc and down into the pins, then filling the plug with wax, a neat and foolproof plug was the result.

The alignment procedure is quite standard and may be summarised as follows:

Set the dial first for equal overlap at both ends of the scale and then tune in your local station nearest the low frequency end of the band. Vary the setting of the oscillator slug to bring the station to its calibrated position on the dial.

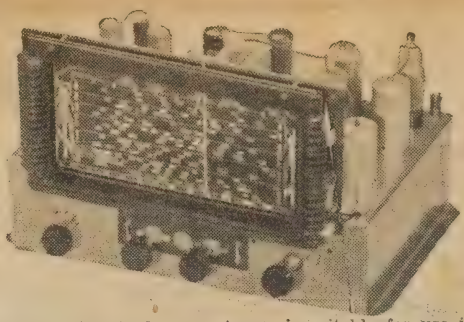
Now adjust the RF coil slug and loop slug (if one is fitted) for maximum volume.

THE TRIMMERS

Tune to a station around 1300-1400 Kc. and bring it to its calibrated position by means of the oscillator trimmer. Adjust the RF and aerial trimmers for maximum volume.

Now carefully vary the settings of the IF transformer cores for maximum volume, turning the loop if necessary, to keep the signal you are listening to rather weak. (The effect of adjustments are always more obvious when the signal is a weak one.)

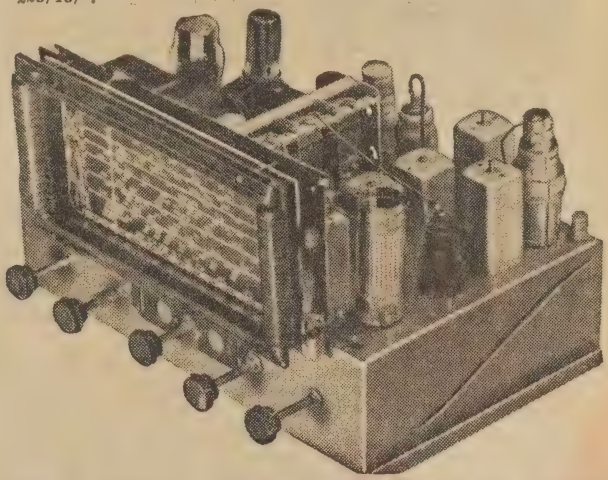
Having adjusted all IF transformer cores, repeat the previous adjustments on the coils and trimmers as a final check. For those who may have access to an oscillator, or who may want the alignment story in greater detail, a reprint article on receiver alignment is available through the shilling query service.



5 VALVE DUAL WAVE RADIO CHASSIS

Complete with 8" speaker and five valves.

This 5-valve dual wave chassis is suitable for use in a radiogram, and is fitted with pick-up terminals ready to be attached to a record player. It can be used with either magnetic or crystal pick-ups, and is supplied complete with escutcheon plate for the large, edge-lit, clearly marked dial. Price £23/15/-. Size 15" x 10" x 9½" high. Valves used: ECH33B, 6SK7G, 6SQ7G, 6V6G, 5Y3G. Supplied with 12" speaker in lieu of the 8". £25/15/-.



ONLY £36/-/- FOR THIS 8-VALVE DUAL WAVE RADIO

Here's value only to be found at Radio House Pty. Ltd. This ready-wired and tested chassis is complete with valves and 12" permagnetic speaker. Complete in every detail, it's easily fitted into your radio cabinet and can be supplied with a polished wood front panel. Ideal for overseas short-wave reception. fitted with phono pick-up terminals, and has tone controls for treble and bass boost.

Valve types and functions:

6SK7—R.F. Pentode
ECH35—Mixer Valve
6AR7—High gain I.F. and diode detector and A.V.C.
6SJ7—1st Audio Driver
6J5—Phase Changer
6V6, 6V6—Push-pull output to Speaker.
5Y3—Rectifier.

Dimensions: 16" x 10½" x 9" high. Weight when packed in crate: 63lb.

Front view with panel attached.

With 12" Permagnetic Speaker.

RADIO HOUSE PTY. LTD.

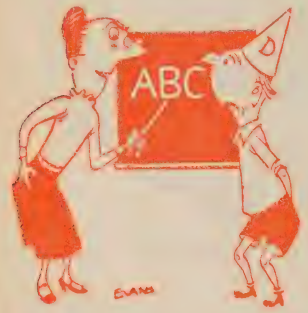
296 PITT STREET, SYDNEY.

Here's your answer, Tom!

Tom's initial worries this month have all to do with grid circuits and bias. He can't quite follow the connection between the bias voltage and frequent references to class A, class B, class C and so on. Well, Tom, we'll do our best to help you.

I find it rather confusing to follow discussion of class A, B and C operation. Just what is meant by these terms?

One might suggest, rather facetiously, that bias problems are far older than radio itself. As long as children have been in the world they've probably pestered their parents with the oft-repeated request to "bias this" and "bias that." What with high prices and the number of Santa Claus to be seen, the 'bias'" question will be very much to the fore during the current festive season. (Shades of Calvin Walters!)



In a radio sense, bias is a lot younger than it ought to be, because its benefits were not generally appreciated until long after the amplifying triode had come into use.

In those early days, it was wonder enough that a small signal could be fed to the grid of a valve to produce a much larger signal at the plate. It was of secondary importance that the signal was often somewhat blurred—the main point was that it was loud!

The blurring of the signals, Tom, which we now more properly call "distortion" was largely due to the fact that the valve did not amplify the incoming signal faithfully. The signal wave patterns would be fed to the grid in a fairly pure form, only to emerge from the plate circuit with the tops flattened, the sides kinked and so on.

It was then discovered that valves could often be made to amplify much more faithfully if a small negative potential was applied to the grid and this came to be known as the "grid bias" voltage.

Since then we've learned a lot more about the use of bias. Instead of being an afterthought, it is one of the vitally important operating potentials for a valve. Just as you arrange for the appropriate filament and plate voltages, so you must apply the correct bias, if the valve is to operate properly.

Now this "class A, class B, class C" business has nothing to do with merit but describes the general conditions under which the valve is made to operate. Why the terms should have been chosen goodness only knows but then, why should we call a thing with six legs an "insect." It's just a name, after all.

However, when the bias is adjusted on a valve so that it amplifies faithfully the whole of the input signal wave, the grid never actually going positive with respect to cathode, we say that the valve is operating under "class A" conditions.

Most of the valves in an ordinary set operate under class A conditions, irrespective of whether they are amplifying at radio, intermediate or audio frequencies. If something were to upset the operating conditions of one or more of these amplifying stages, the signals would probably become distorted. You've learned the first point.

In the course of time, it was also appreciated that valves could be worked in pairs in what is now called a "push-pull" circuit. The immediate benefit of such an arrangement is the ability of the valves to deliver much louder signals than a single valve working alone in the output stage of a receiver.

It was further discovered that the power output (or loudness of the signals) could often be increased by deliberately making the bias more negative than normal and feeding the grids with such a strong signal that they were actually driven positive on signal peaks.

In actual fact, the bias was made so high as to cut off almost completely the initial flow of the plate current, so that economy of battery drain was one of the powerful "talking points" for class B in the early battery sets.

Distortion is avoided, despite the high bias, because the two valves have a complementary action, each one amplifying faithfully the respective halves of the input signal.

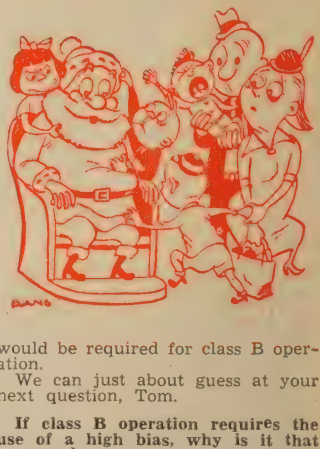
The technique of operating valves with this abnormally high bias and driving the grids harder came to be known as "class B" operation.

Of course, that isn't the end of the story, Tom. The valves have to operate into a suitable order of output load and the driving signal must come from a stage which is, itself, capable of delivering a certain amount of power. Fortunately, you don't have to work all these things out yourself, because the necessary bias, HT voltage, driving power and so on, are listed by valve manufacturers in their manuals.

Compromise conditions have been worked out for modes of operation which lie between pure class A and pure class B operation. These, appropriately enough, have come to be known widely by the terms "class AB1" and "class AB2."

In both cases, the negative bias is greater than would be expected for class A operation. With class AB1, the grids are never driven substantially positive and the previous stage is not called upon to deliver any substantial power to the push-pull grids.

With class AB2, however, the grids are driven well positive on peaks and the drive requirements are similar to those for pure class B. The point of difference is that the initial bias is not quite as high as would be required for class B operation.



We can just about guess at your next question, Tom.

If class B operation requires the use of a high bias, why is it that some valves operate under Class B with no bias at all on the grids?

That's a very fair and logical question. In fact we'll let you into a secret. It puzzled us once too, although we got tangled up the other way round. We noticed that the early class B battery valves operated with zero bias and reasoned that all class B stages would be the same!

However, what we have just said was basically correct. For class A you choose the bias which will ensure faithful reproduction of the signal. For audio work at least, all

SINGLE amplifying stages have to work class A for this reason.

For class B, approximately twice the bias is required as for class A and this will normally be sufficient almost to cut off the flow of plate current in the absence of signal.

For audio work, class B is only used for push-pull stages.

In between the two extremes, you can find class AB1 and class AB2 conditions, as already explained.

Now for the next step. When a valve has a relatively low amplification factor, as is often the case with power output valves, quite a large bias is required for class B operation and this is sometimes awkward to provide.

Recognising the difficulty, valve designers have produced, from time to time, valves which have so many turns on the grid that it severely restricts the natural flow of electrons to the plate. Even with no negative bias on the grid, the plate current in such a valve might be quite low. In other words, it satisfies the class B requirement of being "biased to cut-off" even with zero grid bias.

The moment a signal is applied, it drives the grid positive on the positive peaks and the rest of the bargain is fulfilled.

Well then, why not make all valves that way?

Here's the rub, Tom—because a zero bias valve, designed for class B operation, won't work at all well as a class A amplifier, because the darned thing's always at cut-off!

You haven't said a word yet about class C operation. What does that mean?

Class C, Tom, is a special operating condition which is used mainly in transmitters.

In a class C stage, the grid is biased initially well beyond cut-off but it is driven positive on the extreme peaks of the input signal.

A class C stage doesn't amplify at all in the normal sense of the term. It serves, rather, to deliver abrupt and powerful bursts of signal to a tuned circuit and keeps it oscillating at its natural resonant frequency.

It's just like the pistons in a motor car. They don't deliver power all the time but only in bursts during the power stroke. The big flywheel alternately stores and delivers energy and transmits a relatively smooth drive to the rear wheels, (depending on the make of car).

But don't worry too much about class C right now. Time enough when you begin swatting for your amateur "ticket."

What is the strength of the expressions "A-plus," B-plus," "C-minus" and so on? I can't see any reason for the letters.

To be perfectly frank, we can't either, Tom. The use of the letters has just grown up like the other convention we've been talking about.

Where it all began, we don't quite know and it probably isn't important enought to find out. Sufficient to say that, as long ago as we can remember, the battery supply for the filaments of old-style valves was referred to as the "A battery."

By the same token, the high tension supply for the plate circuits was referred to as the "B-battery," while the grid bias battery fell for the term "C-battery."

It was quite convenient in those days—and I suppose it still is in country areas—to be able to ask for a 45-volt B-battery or a 9-volt C-battery. Imagine what the country store-keeper would say if you were to ask him for "one battery having a terminal voltage of nine and normally used for applying bias to the grid circuits of electronic valves."

He'd probably tell you on the spot that they were in short supply.

The terms do become rather out-of-place, however, in AC sets, which never look like being connected to a battery. There, the AC heater supply may be referred to, rather incongrously as the "A" supply, while the high tension line is commonly referred to as B-plus. The term "C-minus" also turns up occasionally, though mixed up with cathode resistors, back-bias circuits and so on.

CHRISTMAS BOX FOR SOMEBODY!

I have a parcel made up of the following:-

"Communications 9" chassis and panel, DW21 Crown Dial, 8 inch Rola speaker 2000 ohm field, Speaker transformer, Power transformer 385V 80 mil, New valves, 5U4, 1J6, EF50, 2 35L6GT's, used valves, 2 5U4's, 6K8, 35, 6J7, 6F6, quantity of coils, condensers, etc. Any schoolboy reader of "Radio and Hobbies" can have same by dropping me a line. (signed) S. C. Rayner, c/o P.O., Berowra.

Are valves like the 24A and the 35 of any use for battery sets? I am only thinking of the one-valve variety.

No, Tom, you can just about forget them if you have to rely on batteries. The trouble with these valves is that they draw about 1¾ amps at 2.5 volts and this is a fairly solid load, even for a 2-volt accumulator. Not all AC type valves are as heavy on batteries as this but they're bad enough.

You can buy battery valves like the 1K7-G for a few shillings through disposals and they require only a fraction of the filament current.

Is it permissible, in small regenerative sets, to mount the grid condenser and leak inside the can of a Reinartz coil?

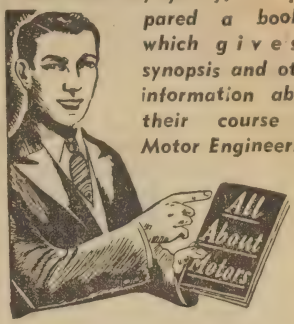
No, Tom, there is no special objection to doing this, and it has its good points. It cleans up the wiring to the detector grid, if it happens to be a top-cap, and also minimises hum-pickup by the two components floating in mid-air.

With some coils, however, it would be a squeeze to get the components inside the can, and physical damage may be done to the coil if care is not taken. One other point is that it may give additional coupling between the grid and reaction circuit, and, in very finicky cases, modify its operation. We said modify, because the effect could just as easily be beneficial as otherwise.

In other words, if you want to mount the components that way, we have no real reason to say you nay.

MOTOR CAR ENGINEERING

The Australian Technical Schools, 3 Jamieson St., Sydney, have prepared a booklet which gives a synopsis and other information about their course in Motor Engineering.



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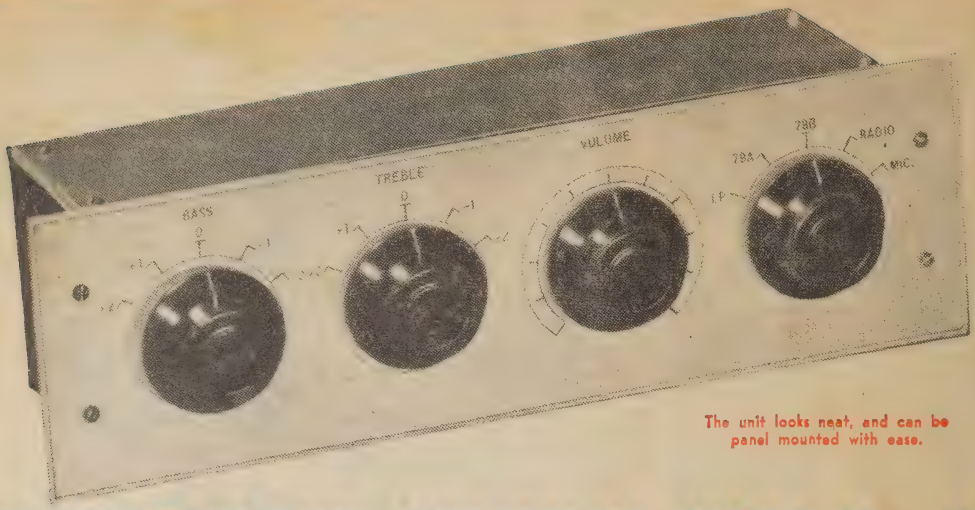


The unit looks neat, and can be panel mounted with ease.

PLAYMASTER CONTROL UNIT No. 2

Here is the Playmaster Control Unit No. 2—more elaborate than the No. 1 but still quite easy to make up. In addition to Volume Control and Selector Switch for various types of records plus radio tuner and microphone, it has extra bass and treble controls to provide further flexibility. Although intended for the Playmaster amplifiers, it can be used in many cases for amplifiers of different design.

YOU will remember that the aim of the PLAYMASTER series of amplifiers is to present a series of equipments which may be used together to form high quality record and radio players.

The amplifiers are self-contained with power supplies, but have only moderate sensitivity, being intended for use with remote control units. These incorporate enough pre-amplification for pick-up connection together with tone compensation and an inlet for a radio tuner. Lastly, there are the radio tuners themselves, none of which has so far been described. We hope to present the first of these in next month's issue.

INTERCHANGEABLE

All the amplifiers, control units and tuners will be interchangeable, so that by suitably combining designs, almost any type of final equipment can be built up, from simple, medium power to extremely high power. The only exception is the PLAYMASTER BABY, described elsewhere in this issue, which is a simple, self-contained record player unit.

We have already described the control unit No. 1 — a small unit containing a pre-amplifier, volume control, and selector switch to provide correct compensation for LP, 78 American and 78 British records, in addition to a radio tuner.

In this article, we describe an elaboration of this unit adding two extra controls. One of these gives two degrees of extra bass boost, and two degrees of bass cut, and the other performs a similar function for treble response.

There are a number of occasions on which these extra facilities are valuable. On records, particularly with low volume, the extra bass boost is able to compensate for the apparent falling-off in this region, and the treble boost also often adds a little brightness and clarity which seems to be lessened. If a record has rather too heavy bass, particularly when the gain is turned up, it is often necessary to cut it down to preserve proportion. Other records might have rather too much surface noise, or have recording faults which can be reduced by cutting the treble.

The same is generally true of radio programmes, where bass boost is quite often a good thing to have.

Both these controls have a centre position in which no compensation at all is provided, and the pre-amplifier plays "straight through" with no change in balance.

In addition to the tone compensation feature, we have the selector switch which selects the required characteristic for the input.

Because this switch provides record compensation not required for radio, the first stage, consisting of one half of the twin triode valve, is cut out, and the input from the tuner is fed directly into the volume control. If the first triode section were left in, it would almost certainly be overloaded from strong radio signals, as even with reasonably good AVC action, the variation between the loudest and the softest station is often most marked. Feeding straight into the volume control allows the best setting to be found, with no danger of overloading the pre-amplifier.

Because the extra compensation is wired into the circuit of the second triode section, it is available for radio also where, as already mentioned, it is quite useful.

by John Moyle
VK2JU

MICROPHONE

The microphone position may not be required in most cases, but it has been added because it is so simple, and the switching allows for it. In this connection, the first triode section is once again inserted in circuit, but with no bass or treble adjustment. The bottom section of the voltage divider circuit is disconnected from earth, thus placing the .2 resistor in series with the connection between

the two stages, where it has little effect on gain. Removal of the voltage divider allows the full gain of the first triode to be obtained, and this is what we want for microphone use. The sensitivity is quite high in this position, calling for careful shielding of the microphone input. We shall have more to say about microphones in a later issue.

We have discussed features of the tone control system used in this unit earlier in the series, and therefore will merely mention here features particularly applicable to the new circuit. Until we reach the second triode output, it is much the same as for control unit No. 1 and the PLAYMASTER BABY.

The input switch has two banks, each switching two circuits into five positions. These are all marked S1 in the diagram, indicating that they are ganged on the switch. As with the other two switches, it is possible to mount the components on the switch itself, soldering the earthed ends to the base plate of the switch to avoid drilling the front panel for solder lug mounting. The only AC in the unit feeds the valve filament, which is not earthed in the unit. Thus earth connection can be made to any convenient point without risk of hum trouble. Ideally, the earth leads for each stage should be taken to one point, but this makes wiring-up hard, and we haven't found it necessary.

VALVE MOUNTING

Both pickup and microphone leads are soldered directly to the switch, thus making connections easy and again avoiding possible hum pickup. These leads run through the back of the removable cover.

The valve is mounted on a bracket bolted to the centre of the panel so that the bolt heads are symmetrically placed between the two centre controls. A couple of terminal mounting strips are bolted to the bracket, and the plate resistors and coupling condensers are mounted to them as indicated in the photographs. It looks as though there is not much room, but you will find that with a little care you can get them in without trouble. Connections for filamen and high-tension are made to one of these strips.

Both the 6 and 5-pin sockets for amplifier and tuner connections are mounted on the back of the cover, with leads a few inches long soldered to them for connection into the unit. You will find it possible to solder these into the unit with the cover partly in place. The small amount of slack necessary in these leads won't run you into any bother. Thus, when the cover is bolted on, you will have two sockets for radio and tuner connection at the back, and a couple of leads running through for pickup and for microphone, if used.

SECOND SECTION

The second section of the triode is connected into a circuit very similar to the first section, in that it also uses a voltage divider type of compensation. If you study it carefully, you will see that the bass boost variation is obtained by using different value condensers in the bottom leg of the divider, and that the bass cut section uses smaller coupling condensers in series with the .05 connected to the plate circuit of the valve.

Treble cut is obtained from the second switch by wiring two values of condensers from the plate of the second triode to earth, and treble boost by wiring two different values straight from the second triode plate to the output, thus bypassing the divider at these frequencies.

You will be wise to mount the switches and volume control in the order shown, as we found that by so doing we could use the least complicated wiring, and group the progression of the signal from input to output without doubling back or awkward component placement. You will find, too, that there will be a certain arrangement of switching sections which will make wiring easiest. To describe these exactly and clearly in words or even in diagrams isn't as easy as it seems, and we would probably only confuse you. So we have included some close-up photos of our own unit in the hope that you can recognise component placement when wiring up your own. In any case, there appears to be nothing particularly critical about the job, although naturally one likes to use the neatest and most compact wiring. You'll find the switches and appropriate components group themselves fairly easily.

SELECTOR SWITCH

The selector switch is a two-bank 2 x 5 type, as is the extra bass switch. The extra treble switch, however, needs only one section of a single bank 2 x 5.

Once again we warn you to connect the grid next to the filament connection on the valve socket to the input section, with its 50,000 ohm pickup load, and not to the arm of the volume control. Failure to do this may result in a small but noticeable "mid-position" hum almost impossible to avoid. But do not in any circumstances earth either side of the filament wiring. In the PLAYMASTERS this filament is positively biased from the output valves of the amplifier, and you will short-circuit the output valves 'bias if you do.

The valve used is perhaps the most suitable of all the dual triodes for this purpose, having a useful gain without too high a plate resistance. There is a certain amount of Miller effect when the volume control is part way on, and this will reduce the response at 10 kc by 2 or 3 db. This isn't important, however, because on all record positions some top cut is desirable.

ALLOWANCE MADE

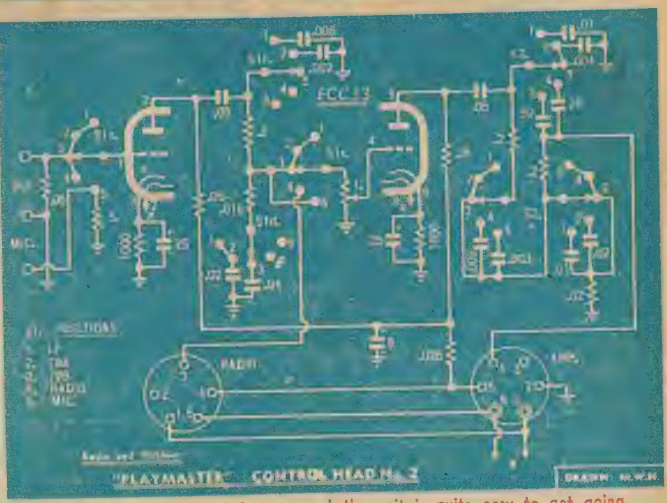
We have therefore worked out the component values to allow for this effect, and used a little less top cut in the circuit. For 78 British records we used no cut at all in the selector, allowing the Miller effect to give us the little we require. On radio, this drop at 10 kc isn't important, and in any case we can make it up by boosting the treble one notch. However, 10 kc response with any tuner isn't its strong point, particularly if a superhet.

The total gain of the unit is about 5 times, which means that with the PLAYMASTER (10 watt version) full output is obtained with about 70 millivolts, and with the SENIOR with about 100 millivolts. This is good enough to give good results from the average lightweight magnetic pickup.

The unit can be used with lightweight crystal pickups but only when connected through the network recommended for the PLAYMASTER BABY described in this issue. Without it, the first triode stage will almost certainly be overloaded.

This unit has been used for some time with PLAYMASTER amplifiers in conjunction with two tuners — one a superhet and the other a TRF type.

CIRCUIT OF CONTROL UNIT No. 2



The circuit has no critical features and the unit is quite easy to get going.

Homecrafts PTY. LTD.

XMAS BARGAINS

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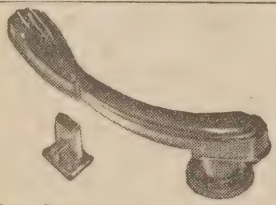

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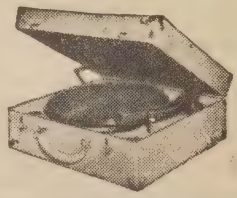

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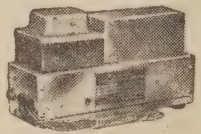

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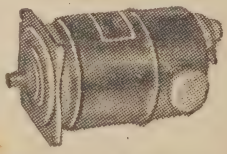

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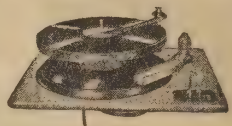

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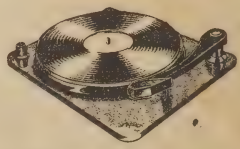

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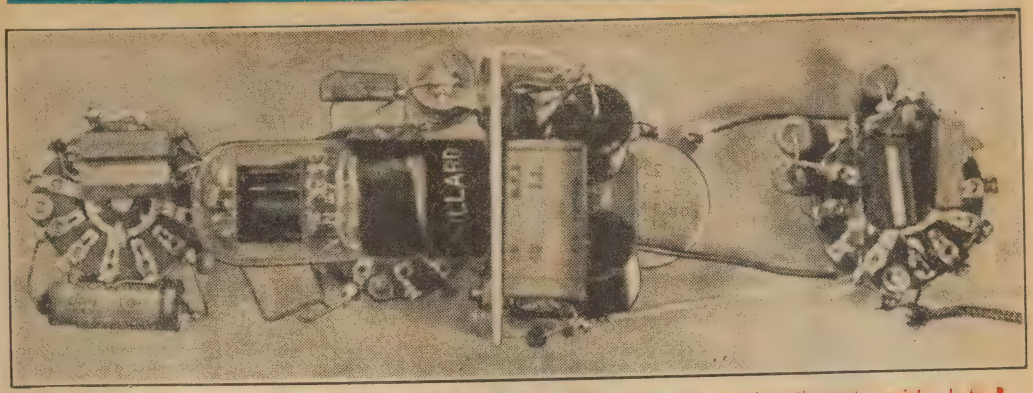


Showing how the controls are mounted to the panel and the valve held by a bracket mounted at the centre point. L to R controls are—bass, treble, volume and selector switch.

It shows no tendency to oscillate or motorboat, is extremely flexible and, except with full bass boost and the volume control open wide, produced no hum.

With full bass boost, corresponding to about 35 db at 50 cycles, we might expect things to happen, and don't be surprised if you get acoustic feedback, for instance, into the pickup head if you use it that way with high volume. Although why you should want to try, I don't know! All that bass boost is strictly a low volume proposition.

Although the compensation circuit in the selector switch is worked out to suit recording characteristics, the extra bass boost begins a little higher up in the scale, thus lifting the "lower-middles" a little bit as well. There is no reason why you shouldn't experiment with different condenser values for both bass and treble if you wish, but you'll probably find our values about right.

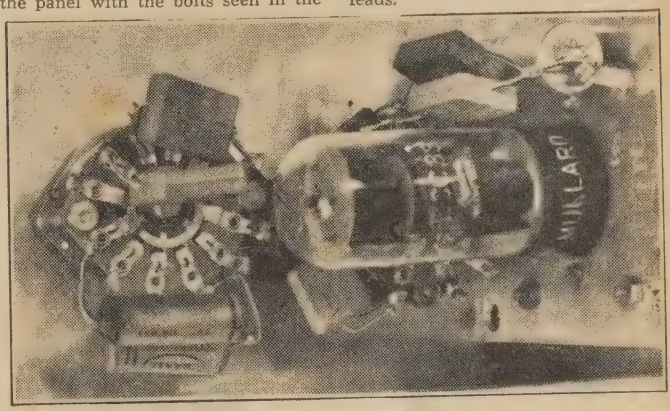
It is possible to use a higher gain valve such as the ECC35 or 6SL7 in this circuit, thus doubling its sensitivity. However, this will possibly call for some alteration to values due to the marked difference in valve plate resistance. We mention it merely for the benefit of the messers-about.

DECOUPLING

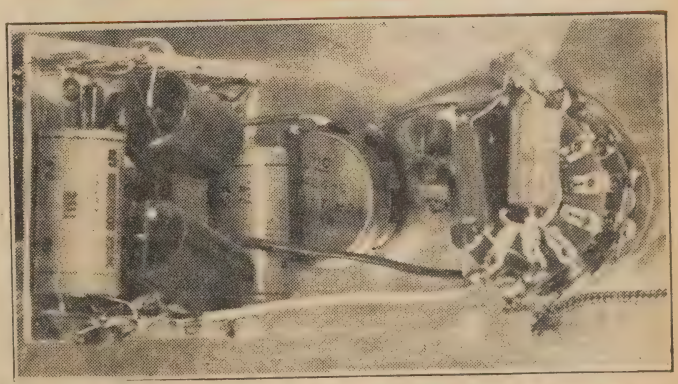
In the remote possibility of motorboating occurring, particularly on radio, with this unit, extra plate circuit decoupling, consisting of an extra 10,000 ohms resistor and 8 mfds. condenser, should cure it. We've tested it pretty thoroughly, however, and don't for a moment think it will trouble you that way.

The only criticism we have of the unit is that, with the gain turned high, thumps will be heard in the speaker if the compensation settings are altered in certain combinations. This can be reduced by operating the controls slowly, and in any case, they are rarely changed under these conditions. The effect could probably be eliminated by using 10 meg. bleed resistors across the bass boost condensers, or perhaps elsewhere in the circuit, and we mention the matter more for interest than anything else. It hasn't worried us, but we may give some thought to it, and perhaps say something further in a later issue. For the moment, we don't want to add further components or complications to "gild the lily."

The front panel measures 11½ x 3½ inches, and the valve socket bracket 2½ x 3½ inches. The case measures 10 x 3¼ x 3½ inches deep, with two lips at each end. These fasten it to the panel with the bolts seen in the front view. The controls are 2½ inches apart, placed centrally in the panel. The 5-pin socket at the back of the case is mounted behind the selector switch, and the 6-pin socket behind the treble control switch. This arrangement will give the shortest leads.



Note how components may be securely mounted to switch points. Midget decoupling 8 mfd is at top right. Don't worry about odd component angles—no one will see them!



This closeup shows underneath valve bracket with plate resistors and coupling condensers supported on two terminal strips. With care, leads can be kept quite short. Note volume control and selector switch.

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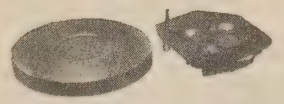

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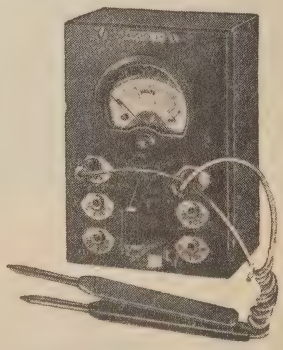

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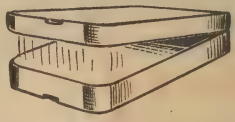

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SERVICEMAN WHO TELLS

(Continued from Page 51)

better than an attempted modification which I had to salvage. It was an old set, dual-wave variety and using an EK2, 6D6, 75, 42 and 80. Furthermore, as far as I could discover, it was of home or "back-yard," and, in its original form, should have been a very good performer. Now, however, its performance was anything but good and the owner admitted that it had been that way for a long time; in fact, ever since it had failed completely and some attempt had been made to modify the circuit.

Slowly, by combining the owner's story with my own findings, I was able to piece together the history. Originally the set had used back-bias, two resistors from the centre tap of the power transformer to earth giving the required voltages for the 42 and the 75 as well as delay voltage for the AVC diode and bias for IF and converter stages. (Fig. 1.)

That was the original set-up, but at some stage of its life one of the back-bias resistors had apparently disintegrated, being quite a common fault in the days before resistor ratings had any real meaning. Someone (I didn't ask who) had attempted a repair, but had elected to change the whole set over to self-bias.

Accordingly, the centre tap of the power transformer had been earthed directly and the grid resistor for the 42 also earthed. Then the correct value of resistor was inserted between the cathode and earth and suitably by-passed. So far so good, and everything according to the book. Now the 75 was treated in like manner, the volume control being returned to earth and the cathode earthed through a resistor condenser network. (Fig. 2.)

DIODE CIRCUIT

At first glance this appears to be correct also, but what our friend had ignored was the diode circuit. By leaving the diode load connected to earth he had very effectively biassed the detector diode as well as the grid, with the result that no detection occurred until the signals were strong enough to overcome this voltage delay. This gave rise to a very peculiar form of distortion, where very weak signals were chopped off completely, stronger ones were reproduced, but with considerable distortion, and very strong ones were reasonably clear.

To give our friend his due, he had not been content with things as they were, and, apparently on the cut and try method, had found that this distortion was much less when the AVC coupling condenser was removed. The reason for this was simply that the stronger signals favored the operation of the unconventional detector and reduced the distortion to less objectionable proportions.

However, this cure produced problems of its own. Without any AVC to control sensitivity, strong signals overloaded the IF stage and produced more distortion. Finally, a manual RF gain control was fitted to the converter valve, and it was necessary to adjust this for a signal which was strong enough to operate the detector, yet not so strong as to overload the preceding stages. In addition the audio volume control had to be adjusted for correct listening level, all of which made tuning in a station a rather formidable undertaking.

(Continued on Page 83)

NOVA

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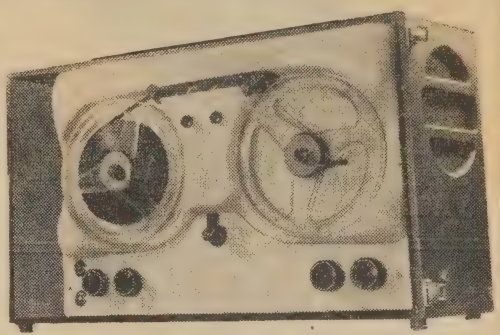

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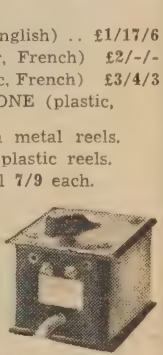

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PART 31—THE FM SOUND CHANNEL

Continuing discussion of the FM sound channel, we describe again this month the operation of the Foster-Seeley discriminator—the first and most widely used type of FM detector. The need for associated limiter circuits is explained together with typical circuit arrangements.

AS in the case of the ratio detector, half the story of the Foster-Seeley circuit is concentrated in the associated discriminator transformer. The function of this was explained at length last month and requires only brief reiteration here.

The transformer has a tuned primary winding and a tuned secondary, the latter normally being split into two equal sections, each having similar coupling to the primary.

An alternative design provides for slightly fewer turns on one-half of the secondary than the other, the lesser half being provided with an iron dust slug, which can be adjusted to give an exact inductive balance.

FOSTER-SEELEY CIRCUIT

The discriminator transformer usually employed with the Foster-Seeley circuit can be represented as in figure 1, which is identical with figure 2b in our last issue.

Signals are transferred from primary to secondary both by direct magnetic induction and by capacitive coupling from the plate. The voltages at the two ends of the secondary are the resultant of the two modes of coupling.

When a signal is applied to the transformer of the same frequency as that to which its windings are resonant, the voltages at the two ends of the secondary are equal.

However, a deviation in the signal frequency causes phase shift to occur, which upsets the balance, so that the voltage at one end of the secondary becomes higher than the voltage at the other. The degree and direction of unbalance depends, of course, on the degree and direction of signal deviation.

This was all covered in detail last month, and reference should be made to the previous article, if the foregoing statements are not understood.

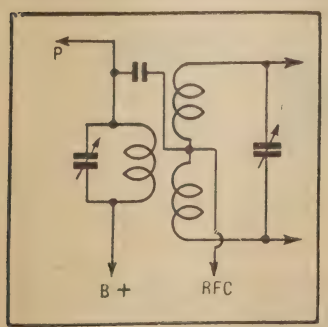

Fig. 1. A discriminator transformer is an essential part of the Foster-Seeley demodulator circuit.

The job of the Foster-Seeley circuit is to resolve the varying conditions of balance and unbalance into an audio frequency signal, similar to that which originally produced them.

The usual circuit arrangement is as shown in figure 2, and its operation is quite easy to understand.

The two ends of the transformer are connected to diode rectifiers, which can well be the sections of a 6H6. Each has its individual diode load and bypass, the return being through an RF choke to the centre of the transformer secondary.

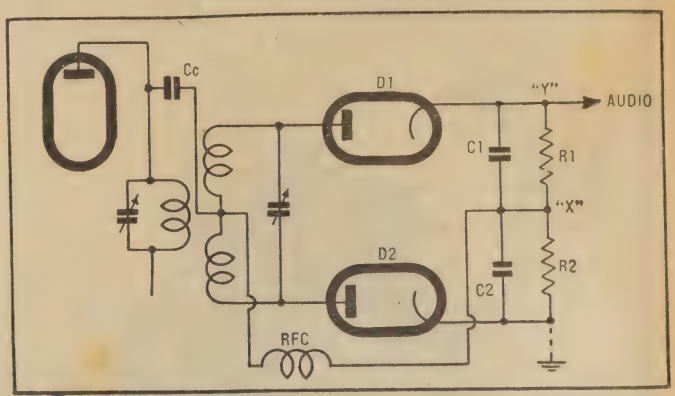

Fig. 2. A conventional Foster-Seeley discriminator. Function of the various components is explained in the text.

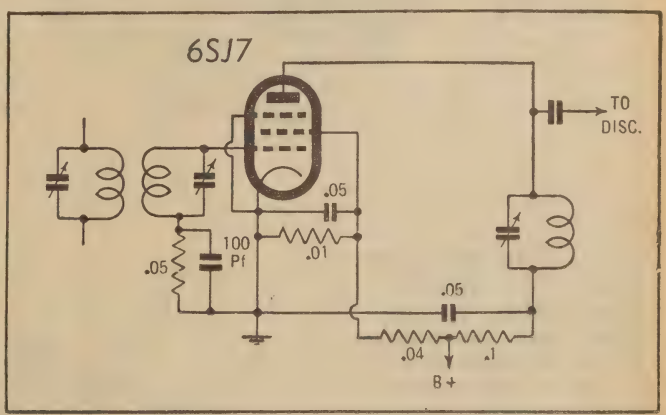

Fig. 3. Circuit of a typical limiter stage. Note grid-leak bias, low plate and screen voltages.

With a resonant input signal, the voltages applied to the two diodes are the same, and, all things being equal, they will develop equal voltages across their respective load circuits R1, C1 and R2, C2.

However, the two loads are effectively in series and the resultant voltage between the outer ends of R1 and R2 will be zero. For example, if both cathodes are, say, 10 volts positive with respect to the junction of R1, R2 (point X), there will be no potential difference between them.

For purposes of reference, it is conventional to earth one cathode,

KINGSLEY

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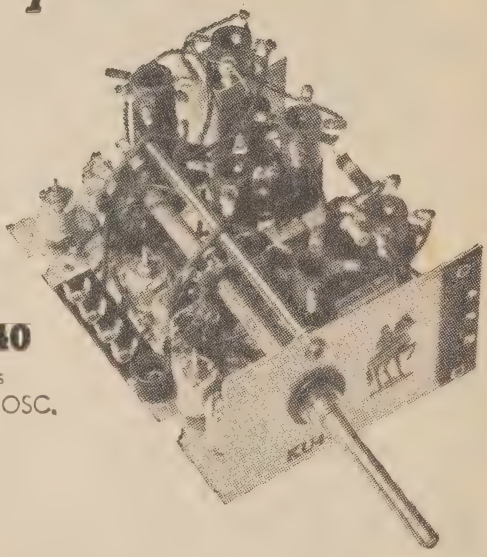
1



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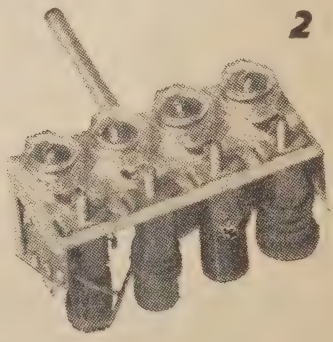

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as shown dotted, so that, with a resonant input signal, the other cathode is also effectively at ground potential.

However, if the signal frequency deviates in a particular direction, the upper diode will receive the greater signal voltage. Therefore, the voltage across R1 will exceed that across R2. The cathode of D1 will be more positive with respect to point "X" than that of D2, so that the resultant will be a positive going audio pulse.

Taking actual figures, if the voltage across R1 increases momentarily from 10 to 12 and that across R2 decreases simultaneously from 10 to 8, then the potential of point "Y" will become 4 volts positive with respect to earth.

On the alternative modulation cycle, when the signal deviates equally in the other direction, the voltage across R1 will decrease from 10 to 8, while that across R2 will increase from 10 to 12. Thus, point "Y" will become 4 volts negative with respect to earth.

The operation of the detector is, therefore, very simple to follow.

However, unlike the ratio detector, the Foster-Seeley circuit is also responsive to amplitude variations, and the reason for this is not difficult to understand.

If, for any reason, the peak value of the incoming signal is increased, so also will be the voltages developed across R1 and R2. Thus, a 20 per cent increase in signal amplitude will produce, at resonance, say, 12 volts across each resistor, and zero potential at point "Y."

But, off resonance, with the same percentage of deviation as before, the voltages across R1 and R2, respectively, will be 14.4 and 9.6, giving an out-of-balance resultant of 4.8 volts instead of 4.0 volts. In other words, a 20 per cent increase in peak signal voltage, off resonance gives a 20 per cent increase in audio signal output.

LIMITER STAGES

As far as noise pulses are concerned, all impulses which reach the two diodes at frequencies other than the exact resonant frequency of the system will produce an audio component.

It follows, therefore, that a receiver using the Foster-Seeley discriminator will not be free from AM interference unless special precautions are taken to prevent AM variations reaching the discriminator. This task falls to the so-called "limiter" stages, of which there may be one, two or even three in an extreme case.

Thus, one or more limiters are invariably provided ahead of a Foster-Seely discriminator, but they are rarely used in conjunction with a ratio detector, which is inherently unresponsive to amplitude variations.

A limiting amplifier looks much the same as an IF amplifier stage, and, in fact, it is one. However, the operating conditions are adjusted so that it functions normally in an overloaded condition—just the reverse to AM practice.

GRID BIAS

This is achieved by eliminating all gain control from the preceding stages, so that a very heavy input signal is applied to the limiter grid. The valve itself operates with low plate and screen voltages, so that it has no chance of dealing adequately with the signal fed to it.

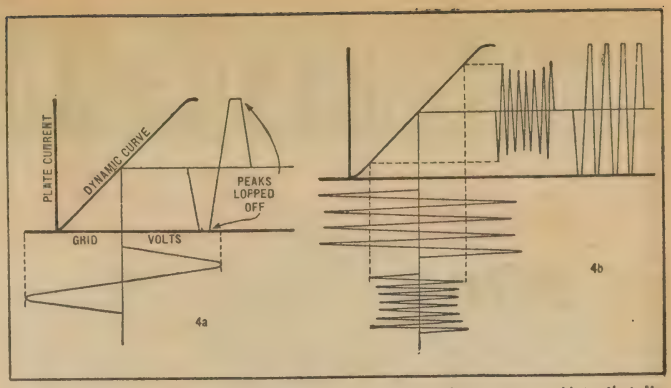


Fig. 4. This curve illustrates graphically the action of a limiter stage. Note that it functions only on large input signals.

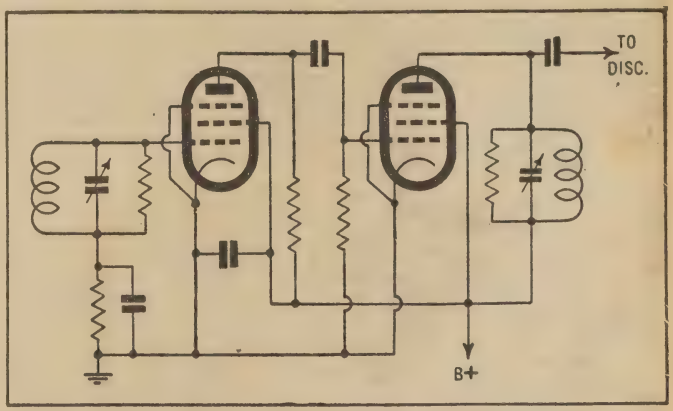


Fig. 5. A typical two-stage limiter using resistance coupling to avoid trouble with IF channel instability.

Figure 3 shows the circuit of a typical limiter stage. It will be noted that the sharp cut-off valve is used, in this case a 6SJ7, although other high-slope valves are commonly employed.

The only bias provided is that which can be generated across the grid return resistor and bypass. The plate voltage is applied through a 0.1 meg. resistor, while the screen voltage is also lower than usual.

NO DISTORTION

Positive-going pulses cause grid current to flow and produce a standing bias across the grid return resistor and bypass.

Individual pulses tend to be reproduced in the plate circuit by the natural action of an amplifier valve. However, the limited plate and screen voltage prevents the plate current from achieving a high peak value, the output wave tending, instead, to be flattened at the top.

On the reverse half cycle, negative-going pulses reduce the current from its already low figure to cut-off, which, of course, represents the limit in this direction. Thus, excursions of plate current, both up and down, are severely limited.

In an AM receiver such a condition would lead to intolerable distortion; the varying amplitude of the signal contains the modulation, and the shape of the modulation envelope must be preserved at all costs.

In the case of an FM signal, the significant feature is the frequency variation and the amplitude can be subject to severe limitation without danger of creating distortion.

It follows that the limiter stage of figure 3 will not exercise a complete limiting action on a weak input signal, since the variations in amplitude may lie completely or in part within the dynamic operation of the tube.

For the limiting action to be complete, it is essential for the input voltage to "swamp" the grid circuit completely, so that amplitude variations due to noise are not reproduced in the plate circuit, due either to the valve being operated past cut-off on the one hand and in the region of plate current saturation on the other.

These points are illustrated graphically in figures 4A and 4B. Figure 4A shows how the plate current peaks are flattened when the grid signal voltage swings the valve beyond the ends of its dynamic operating curve. Figure 4B illustrates the action of the same valve with both strong and weak input signals carrying a certain amount of AM noise modulation.

The figures make it obvious why high gain is required ahead of the

(Continued on Page 95)

SOME POINTS ON TAPE RECORDING

Brochures which have come to hand recently from the manufacturers of "Scotch" recording tape contain sundry items of information which will be of interest to tape recording enthusiasts. The contents of some of these bulletins are reprinted under the appropriate headings.

VISIBLE TRACKS ON MAGNETIC TAPE

THE sound track recorded on magnetic tape may be made visible by means of a method which is similar to the mapping of fields around magnets by means of iron filings. The iron particles must, of course, be smaller than iron filings. The particles which are used are carbonyl iron with a diameter of about 3 microns—or about 0.0001in.

In addition to being small, the particles must be able to move about so that they can settle in regions where the tape is strongly magnetised. In order to provide the desired mobility, the carbonyl iron may be dispersed in a light oil or in a volatile substance such as heptane. Even ordinary water may be used.

In order to see the track recorded on a piece of magnetic tape, the simplest method is merely to pass the recorded tape through a suspension of carbonyl iron heptane. The heptane quickly evaporates, leaving the carbonyl iron particles settled on the regions which are most strongly magnetised.

The photographs illustrate typical sound track patterns which have been made visible in this manner. The longer wave-lengths recorded on the tape are evident to the naked eye. Very short wave-lengths, as short as 0.001in, may also be observed.

In the case of the short wave-lengths, more satisfactory results are obtained if the carbonyl iron is dispersed in a light oil instead of being suspended in heptane.

The track made visible in the manner described above has a number of uses. One application of the method is to permit an evaluation of the degree of alignment of magnetic heads. This requires a study of very short wave-lengths. One can determine with a microscope whether or not a recorded track is perpendicular to the direction of tape travel.

Another application is in editing, which may be facilitated by making the sound track visible. Relative positioning of the sound tracks in multi-track recording may also be examined. Defects which contribute to noise are found by using a microscope to examine the visible track.

The method cannot be used to reveal weakly recorded signals and, for best results, a fairly high signal level is necessary.

LAYER-TO-LAYER SIGNAL TRANSFER

When a length of recorded tape is wound into a reel, each layer of tape is in the magnetic field of its neighbors. Since any magnetic material placed in a field tends to be magnetised to some degree by it, each layer is magnetised to some extent by its adjacent layers.

The important point is the degree of the magnetisation, which may vary from totally undetectable, the normal condition, to nearly as large as the adjacent layer, in case of accidental exposure to external magnetic fields. While our investigations have been quantitative, this brief summary will be largely qualitative, and concerned not with explanations or theory, but with the major techniques in keeping the effect small.

The effect is non-linear; i.e. transfer is like recording with no bias. The transfer level will decrease perhaps 2 db for each 1 db decrease in recording level. Thus, ordinarily effects are noticed, if at all, only as a result of a very heavily modulated or overloaded portions of tape. Therefore, the signal to transfer ratio may be increased by lowering the recorded level.

The effect increases with time of storage, over a period which may vary from several days to several months, depending on the conditions of storage. In practice, transfer cannot usually be detected except after considerable time.

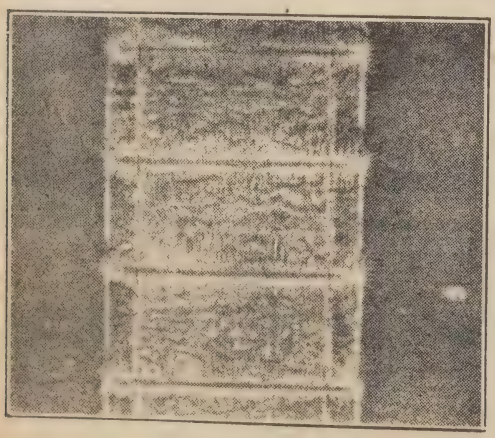
The effect increases with temperature. The temperature coefficient is not the same for all tapes and all times of storage, but is approximately 1 db per 10 deg. F. Thus it is advantageous to keep recorded reels in a cool place.

The transfer effect is usually well below the noise level if the recorded reel is kept away from all stray magnetic fields. Such fields (AC or DC) can act to increase the transfer by a few or even 30 or 40 db. Most cases of objectionable transfer can be ascribed to this cause.

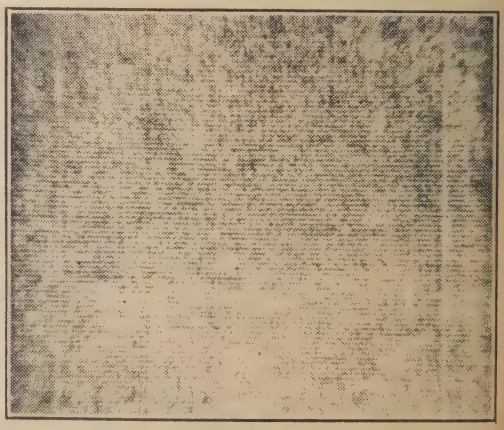
Whereas fields of the order of several hundred oersteds are required to cause even a measurable erasure and one or two thousand oersteds for complete erasure, transfer may be noticeably increased by fields of only a few oersteds. It is therefore important for the highest quality work to keep the recorded reel away from any sources of stray fields, such as motors, heavy power lines, magnets, &c.

The effect is frequency dependent, with middle frequencies most important. Low frequencies are weakly transferred because the field strength associated with long wavelengths is less than with shorter wavelengths of the same magnetisation. This,

(Continued on Page 103)



A 75-cycle note recorded at 7½ in/sec. The fringing at the sides and some laminations effects were clearly apparent in the original. A noisy tape was selected for the test, the noise being seen as irregularities between the recorded poles.



A photomicrograph showing a pattern of fine high frequency lines obtained with oil suspension. The wavelength is .002 in., so that the lines are .001 in. apart. Lamination defects are apparent as streaks running at right angles to the pattern.

TRADE REVIEWS AND RELEASES

PHILIPS RELEASE NEW TEST INSTRUMENTS

Philips Electrical Industries of Australia Pty. Ltd. announce the release of a new range of test instruments which should be of interest to laboratories, radio and industrial organisations and to servicemen. One of these, the "Philoscop II" is illustrated opposite.

IT is an AC-operated bridge type instrument which uses a small "magic-eye" type indicator in place of the usual galvanometer.

Of special interest is the fact that the instrument may be used as a conventional bridge to compare resistors, capacitors, or inductors against known external standards. The deviation may be read directly on a percentage scale, enabling the instrument to be used by unskilled personnel. The cathode ray indicator is useful in this regard also, as it cannot be damaged by overload.

The unit also has its own internal standard resistors and capacitors, which enable it to be used as a direct reading-instrument with a range of .5 ohm to 10 megohms and from 1 pf to 100 mfd. This coverage is spread over six ranges in both cases.

It is possible to read insulation resistance (of condensers, &c.) up to 200 megohms, to determine the loss angle of electrolytic capacitors, and to regenerate electrolytic capacitors from a selection of five DC voltages ranging from 10 to 250 volts. The instrument may be used with any AC supply system, with a frequency of 40-100 cps and from 110 to 245 volts in six steps covering the most usual values of supply voltage.

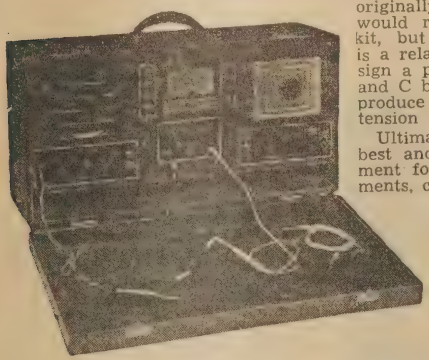
Tested in our own laboratory the instrument was found to be well made and finished. In use, the maker's claims were fully justified and it would appear to be a very versatile and useful instrument. The scales are not quite so easy to read as those found on some simpler instruments, however, and a certain amount of practice may be necessary in order to work out the number of significant figures involved or the placing of the decimal point. This should not present any real problem to persons accustomed to working with instruments of this kind.

Price is £38/7/6 net, plus 12½ pc where applicable, and subject to change without notice.

Further details from Philips Electrical Industries Pty. Ltd., 69-73 Clarence St., Sydney.

AC POWER UNIT FOR A.R.C. KIT

Following the announcement in June this year of a practical "Kit Course" for home-study radio students, the Australian Radio College advises that an AC-operated power supply is now available to suit this kit.



IT was stated in the June announcement that this Kit Course had been designed to operate from dry batteries, mainly because many students taking correspondence courses are in remote districts where no power is available. It was stated that an AC-operated power supply would be available for students in wired areas. We have been advised by the college that these units are now available.

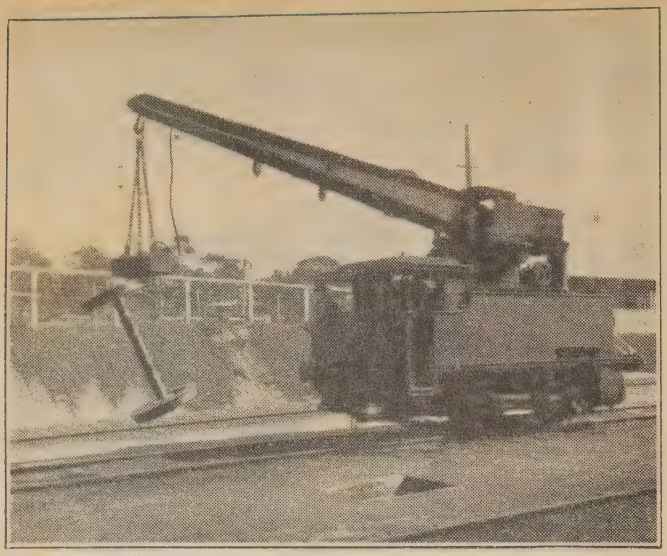
The college technical staff had originally visualised a unit which would replace all batteries in the kit, but they point out, while it is a relatively simple matter to design a power unit to replace the B and C batteries, it is very costly to produce a stable well-regulated low tension supply for the filaments.

Ultimately it was felt that the best and most economical arrangement for operating the test instruments, constructed in lesson 9, from the power mains, would be to retain a large 1.5 volt dry cell as the A battery and to build a unit which would furnish approximately 67½ volts for the signal tracer, about 45 volts for the oscillator and a negative bias of about 6 volts.

A large dry cell with a potential of 1.5 volts is not a very costly item and its life under normal operating conditions should be about 12 months. This is regarded as being a more economical arrangement than a low tension power pack with its expensive rectifier and filter components.

Further information about this course will be gladly supplied by the Australian Radio College whose address is 206 Broadway, Sydney.

Q-Plus announce a new ange of standard coils, RF, aerial, oscillator, and IF transformers, which are fitted with an improved type of soldering lug. The details are shown in the illustration above and the lugs are intended to replace the older style wire pins and to provide better soldering facilities.



Here is an excellent example of practical use of magnetism. It is a magnetic crane belonging to the NSW Government Railways. The wires to carry the electric current are just to the right of the supporting chains. The crane will release the axle as soon as the current is switched off. Note that there ar eno hooks.

by Maurice Findlay

For the young experimenter

THE UNIVERSE IN MINIATURE

Every chemical atom is just like a tiny solar system, every particle of matter is a universe in miniature. With the very simplest pieces of equipment, you can demonstrate and explore some of the facts—and the mysteries—which form the basis of this modern age of electronics.

LAST month we showed you some of the things that can be done with static electricity, generated by rubbing a plastic rule with woollen cloth and a glass rod with silk cloth. You will remember that we made a little instrument called an electroscope and used it to study the effects of the electric charges.

We found that we could generate a negative charge of electricity by rubbing the plastic rule and a positive charge by rubbing the glass rod. Further, that there is a mechanical attractive force between a pair of unlike charges, while a pair of like charges, whether positive or negative, tend to repel each other.

ELECTROSTATICS

By holding the charged rule near another body which is able to conduct electricity, we were able to make an electric current flow for a small fraction of a second and note the tiny spark which results. We found also that some substances are able to retain the electric charges while other substances conduct the charges away from the point at which they are generated. The former are called insulators and the latter are called conductors and we gave a few examples of both.

This month our purpose is to explain these phenomena in terms of the electron theory and in doing this we will need to know something about the structure of matter.

STRUCTURE OF MATTER

When we speak of matter we refer to everything in the universe. The pages of this magazine, the ink that is used to print the words in this sentence, the water in the ocean, the steel that goes to make up the Sydney Harbor Bridge, &c., are all forms of matter and have a certain fundamental similarity in their make-up. You know, of course, that steel has qualities which are quite different to those of paper. For instance, if the pages of Radio and Hobbies were steel sheets, they would be very much heavier and at the same time very much harder to manipulate.

The field around a bar magnet demonstrated with the aid of iron filings sprinkled on smooth cardboard placed above the magnet.

But paper and steel are both made up of tiny particles which we choose to call "molecules." Now a molecule is extremely small. There are billions of molecules in the head of a pin but each molecule has the same properties that of the steel which goes to make up the pin. In fact, we can define a molecule as the smallest particle of matter which can exist separately and still retain the special characteristics of the particular substance.

A molecule of water, for instance, is so small that it could not be seen with the most powerful magnifying-glass and yet it still has all the properties of water.

Still smaller than the molecule is a particle called the "atom." We could define an atom as the smallest particle of a chemical element that can exist and still retain the characteristics of the element. The gas hydrogen is an element and the smallest particle of hydrogen that

will behave in the same way as hydrogen is an atom of hydrogen.

Thus, by the definition, the atom of hydrogen and the molecule of hydrogen are one and the same thing. However, in the case of steel ,this is not the case. A molecule of steel may be made up of atoms of iron, carbon, cobalt, &c. These atoms are different in their make-up and have different chemical properties. If we were to take all the atoms of iron from the steel we would no longer have steel. Again, if we take a single atom of iron and succeed in breaking it up into smaller parts, we no longer have iron.

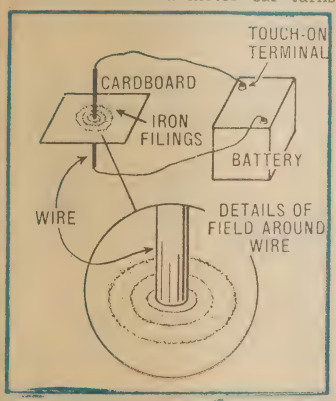
We could pursue this discussion further but only by becoming involved in chemistry and that is not our purpose at the present moment.

ELECTRON THEORY

Getting back to the hydrogen atom, it is conventionally supposed to consist of a positively charged centre portion, or "proton," and a negatively charged particle which revolves around the proton called an "electron." We have represented this in the diagram.

The electron is very small and light when it is measured in terms of inches and pounds weight but nevertheless it has a definite size and weight which scientists have been able to estimate.

You are probably familiar with the effect when a motor car turns



Setup for demonstrating the magnetic field around a straight piece of wire. A heavy-duty battery is necessary to supply the very heavy current.

a corner sharply. The car and the passenges tend to keep going in a straight line and it is only the force of the tyres on the road that succeeds in turning it. If you are going very fast and try to turn the car sharply, there is a very great force between the tyres and the road, as evidenced by squealing noises.

It is the same with the electron. But instead of the force between the tyres and the road it is kept in its circular path by the force of attraction between the positive and the negative charge. In fact, the two just balance each other so that the electron keeps on the same path all the time.

The hydrogen atom is the simplest of the 92 chemical elements.

This home-made compass takes only a few minutes to make. Leave the clock spring bent, as it will be easier to balance on the point.

Some of the more complicated chemical elements have dozens of electrons revolving around a complicated nucleus consisting of dozens of positively charged particles.

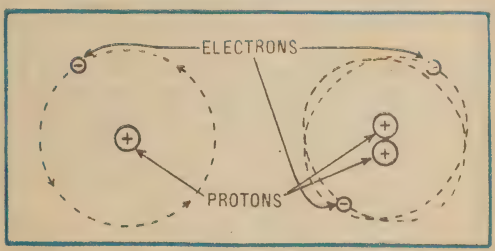
In the case of certain atoms it is quite easy to detach one of the revolving electrons and pass it on to the next atom which in turn passes it on to the following atom, &c.

If this substance, with the free or easily detached electron, is made up into the form of a wire it is quite easy to conduct a charge of electricity from one point to another. In fact, the ability of a substance to conduct or otherwise depends on its atoms having these "free" electrons.

WHAT IS ELECTRICITY?

Having gone through all this we can answer, in one sentence, the original query, "What is electricity?" Electricity is simply a flow of electrons.

For example, if we take a length of copper wire (remember, copper is a good conductor) and place a positive charge at one end of the wire and a negative charge at the other end, a current will flow through the wire.



Representation of two simple atoms. Many atoms have dozens of electrons revolving around a complicated nucleus.

Of course, if the charge is of the type we generated last month the current will only flow for a very short period but it is possible to construct a thing called an electric cell which will supply a continuous electric current. Having established this flow of electric current we find that there are a number of very interesting and at the same time very practical things that can be done with it.

We have one point yet to explain and that concerns the generation of the electric charge in the rule. The explanation is simply that when the rule is rubbed with the woollen cloth some of the electrons from the cloth are rubbed off the cloth on to the rule, leaving the cloth with a deficiency of electrons or a positive charge and the rule with an excess of electrons or a negative charge.

As proof of this, try holding the cloth you have used to rub the rule near the electroscopes. Due to leakage it may not be possible to get a very strong charge but you will be able to verify the truth of the argument.

By some trick of nature, exactly the opposite happens when the glass rod is rubbed by the silk. Some of the electrons are rubbed off the glass on to the silk, leaving the glass with a positive charge and the silk with a negative charge.

When a current of electricity flows through a wire it causes the wire to become warm. As a matter of fact, if you pass too much electric current through a wire you can cause it to melt. It is on this principle that the fuse in your domestic light circuit works.

HEAT FROM ELECTRICITY

You may have noticed an electrician replacing a fuse. It simply consists of a fine wire stretched between two terminal posts. In order to reach the electrical apparatus inside the house, the current has to flow through the fine wire. If, due to some fault in the wiring, the current becomes too great, the fuse will become hot. Then, if the overload is left on for an appreciable time, the wire will melt. Of course, after the wire has melted, the circuit is broken and the current can no longer flow. The overload is, therefore, automatically disconnected.

Just say, for instance, that there were no fuse in the circuit when the overload occurred. The whole length of the wiring throughout the house would become hot until, eventually, the thinnest part of the wire would melt. The thinnest point is just as likely to be somewhere up in the roof, where it is very difficult to find, much less fix, and every time some electrical gadget developed a fault, it would probably be necessary to renew most of the wiring.

But this heating effect of an electric current can be used in many useful ways, with which you are

The "AVO" ELECTRONIC TESTMETER

Developed to meet the demand for an instrument of laboratory sensitivity built in a robust and portable form, the AVO Electronic Testmeter is for use where it is imperative that the instrument should present a negligible loading factor upon the circuit under test.

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The thermionic circuit gives delicate galvanometer sensitivity to a robust moving coil movement. The instrument is quickly set up by a main Range Selector switch and two subsidiary multiplier switches.

The instrument operates on A.C. mains 100-130 V. and 200-260 V., 50-60 c/s.
SIZE: 12½" x 9" x 5½".
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already familiar. An electric radiator, for example, has a coil of wire which is heated by the passage of an electric current. The coil is so arranged that there will be just sufficient current passing through it to keep it at a glowing red temperature. If excessive current were passed through the coil, it would melt in the same way as the fuse.

An electric toaster works in just the same way, except that the wire is arranged in the form of a flat coil so that it will toast the bread evenly. The electric iron has a similar element, so that the flat surface is heated all over. Electric water-heaters have a coil of wire around the pipe carrying the water and the heat from the wire is transferred to the water as it passes through the pipe.

ELECTRIC LAMPS

Another important everyday instance of the use of an electric current for heating is the electric light globe. A very fine filament of wire is heated to a high temperature by the passage of an electric current. Tungsten is normally used because it can be made white hot without melting and the white hot metal gives off the light. If you hold your hand near the globe you will notice that it is quite hot. Actually, more of the electrical energy put into the globe goes into heat than goes into light.

If the hot filament were exposed to the air it would become oxidised very quickly, so it is enclosed in a glass envelope which is either evacuated or filled with an inert gas.

Perhaps you have seen a motor car with yellow or reddish-colored lights. This is probably caused by the car having an undercharged battery, so that the current through the lamp filaments is not great enough to make them white hot. You may also have noticed the same effect in the case of an ordinary torch when the batteries are nearing the end of their life.

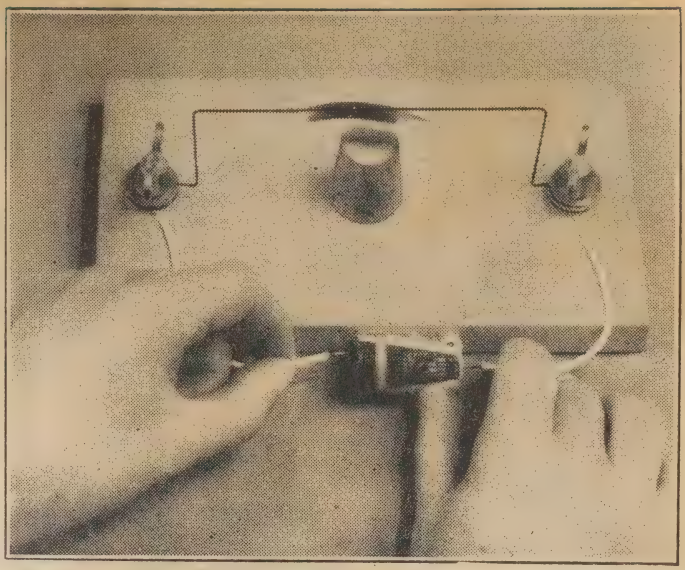
When an electric current passes through a wire there is another effect which is just as important as the heating effect and on which electric motors and countless other devices depend.

ELECTROMAGNETICS

When a current is passed through a wire, there is a magnetic field surrounding the wire. As soon as the current stops the field ceases to exist, but can be made to reappear again immediately the current starts to flow. This is called "electromagnetism" because it is entirely dependent on the current flowing. Exactly the same things as can be done with a permanent magnet can be done with a very great advantage to be able to switch the magnet off when required.

An electromagnet has many practical advantages when it comes to the design of big motors to drive machines and it is very much more convenient than an equivalent permanent magnet.

You have probably observed the effects of a permanent magnet at some time or another. Perhaps you have used one to pick up pins from the floor. Magnets of this type are usually in the form of a horseshoe, but they can be made in the shape of a bar if necessary, or any other way that is convenient.



This is a simple way to demonstrate the magnetic field surrounding a wire through which an electric current is flowing. It is described in detail in the text.

At any rate, no matter what the shape of the magnet, it has a property of attracting small pieces of iron and steel. Unlike the electric charges we dealt with last month, it does not have the slightest effect on pieces of cork, silk, glass, ebonite and all the other insulating materials. Strangely enough, it does not have any effect on metals, such as aluminium, brass and copper, either, but, if a magnet is dipped into a heap of steel pins or iron filings, they will adhere quite firmly to it.

Another interesting point to observe is that if two permanent magnets are brought near to each other there will be a force between them. It may be an attraction or a repulsion, depending on which way the magnets are presented to each other.

Leaving this for a moment, it is interesting to note that the earth itself behaves as a huge magnet, one end of which is near the geographic North Pole and the other end of which is near the geographic South Pole. Of course, the magnetic field of the earth is relatively weak and it is not ordinarily possible to note the effect of the earth on small pieces of iron. However, if a small piece of iron or steel is magnetised and set up on a pivot so that it can turn easily, it will turn so that the ends point to the magnetic poles.

MAGNETIC COMPASS

Furthermore, if you mark one end you will find that provided the magnet is free to turn and there are no other magnets in the vicinity, this end will always point in the same direction. That is, one end will always point toward the North Pole and the other end toward the South Pole. If you have a magnet at home you can try this experiment.

If it is a bar magnet tie a piece of fine silk thread around the centre of the magnet and hold it up in the air. In the case of a horseshoe magnet tie the thread to the centre of the horseshoe allowing the open ends to hang down. Note which end of the magnet points toward the north and mark this end with a piece of chalk. This is the north-seeking pole of the magnet, or, as it is usually called, the north pole.

You will probably know roughly which is north and south in your district, but, if not, you will be able to get some idea of this by checking with a map. Having obtained a rough idea, you will be able to get an exact check from your magnet, or "compass," as it really is.

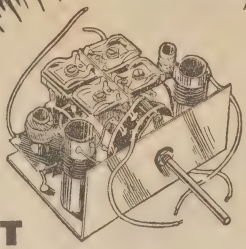
While this form of compass works quite well, it is somewhat heavy and clumsy to handle, and we can do much better by making a small magnet from a piece of clock spring and balancing it on a needle as we have shown in the photograph.

COMPASS NEEDLE

For a piece of steel to retain its magnetism permanently, it must be hardened. Soft iron will lose its magnetism almost immedately after the current is switched off. Sometimes it is desirable for this to happen, but at the moment we wish the magnetism to stay in the compass as long as possible, so we use hardened metal. The spring of a clock is excellent for this purpose because it can easily be broken into the required length, and, being hard, will retain its magnetism for a long time.

We asked a watchmaker for an old clock spring, and he turned up with a length about 3-8in wide which had served its useful life in a clock. By gripping one end of the spring in the vice so that a small portion protruded over the jaws, a gentle tap with the hammer was sufficient to

HITS in KITS !



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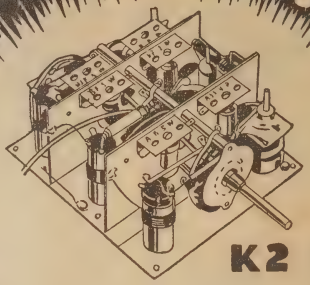

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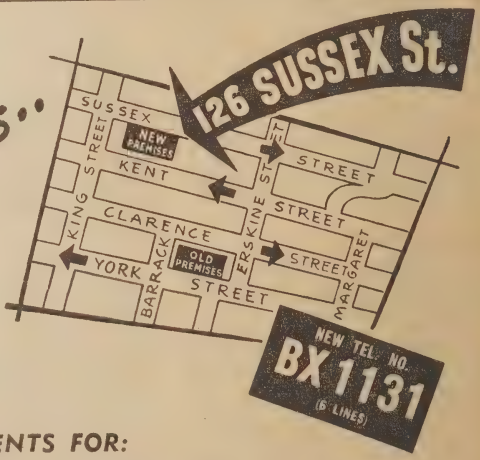

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break the end of the spring off neat and straight.

Break off 2in or thereabouts in the same manner, then, with the aid of a nail and a hammer, make a small dimple in the exact centre of the length of spring. The dimple is to facilitate balancing the spring on the end of the needle. You will note from the photograph that we have pushed the needle through a large cork in order to give it a firm support. By the way, it is better to leave the spring curved, because otherwise it is very difficult to balance.

The next step is to magnetise the piece of spring, and the easiest way to do this is with another magnet. The procedure is to touch one end of the spring on one pole of the magnet and rub the magnet pole along the length of the spring.

Now, balance the spring, which is now itself a magnet, on the needle, and you will find that one end will always try to point to the north. Mark this end for reference purposes. It is the north-seeking pole or north pole.

While you are about it, it is a good idea to make two of these little compasses so that you can study the effect of the magnetic poles on each other. It is not essential to have two stands, as you can use the one stand while determining the magnetic polarity, and thereafter the second piece of magnetised steel may be held by hand.

The next part of the experiment is most interesting, and it proves a law which is fundamental to the study of magnetism.

Balance one of the magnets on the needle and then bring the north pole of the magnet held in the hand near the north pole of the balanced magnet. Instead of being attracted, as you may have expected, the magnet does its best to get away from the hand-held magnet. Try the experiment again, but this time hold the south pole of the magnet near the north pole of the balanced magnet. This time the effect is reversed, as the two attract each other.

If you like, you can repeat the same experiment with the south pole of the balanced magnet. Note that when the two south poles are brought together they repel each other, while, again, a north and a south pole attract each other.

UNLIKE POLES ATTRACT

From this you will have gathered that two like poles repel each other, while unlike poles attract each other.

All this time you will have been wondering what is the invisible force of attraction between the two magnets. The answer is simply that it is one of the tricks of nature. There are no invisible elastic bands between the two pieces of metal or any other such mechanical connection. The attraction is simply due to what we choose to call a magnetic field.

There is a very simple and effective means by which magnetic fields may be made apparent to the eye. The idea is this. Place a piece of smooth white cardboard over the magnet you wish to study, and then, gently and evenly, sprinkle some iron filings over the area of the magnet. If you don't have any iron filings, the so-called "plastic steel" powder will work just as well. As a matter of fact, we used this to obtain the pattern shown in the photograph.

As the powdered iron falls on to the paper it will take up a characteristic pattern. Note that the iron forms itself into a series of lines which are smooth curves. None of the lines cross over each other and you will find that you will be able to trace a number of unbroken lines from one pole to the other. If the pattern is not too clear, try tapping the paper gently, as this will allow the iron powder to move under the force of the magnet.

MAGNETIC FIELDS

The explanation of the behavior of the powdered iron is this. Each tiny particle of iron itself becomes a magnet by "induction," that is, by being in the field of the large magnet. The tiny magnets have clearly defined north and south poles in just the same way as the large magnet and the north pole of one small magnet is attracted to the south pole of its neighbor and so on, until they form a complete line. At either end of the line the particle magnets are attracted to the large magnet itself.

If you have a number of magnets of different shapes try the experiment with the iron filings and the paper on all of them. It only takes a few seconds when you have the required materials on hand. Try also putting two unlike poles close to one another under the cardboard. Note how the pattern suggests force of repulsion between the two magnets.

We spoke earlier of electromagnets or magnets which could be switched on and off when required. In its very simplest form an electromagnet consists of a length of wire with an electric current passing through it. Wtih the help of our home-made compass and a length of wire, together with a battery, it is quite easy to demonstrate this.

We need some means of making a current flow in the wire. It may be a battery or some form of generator, if you happen to have one on hand. Perhps you have a partly worn-out battery from a torch. If so, use this rather than a new battery, because the experiment is not very kind to the battery. It allows more current to flow than the battery is designed to deliver. If you have to buy a new battery, buy the cheapest single cell available.

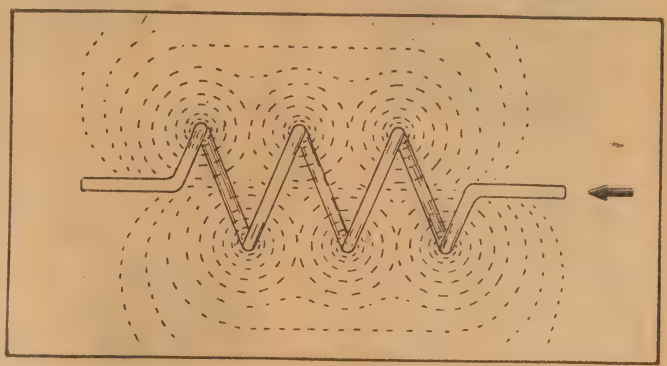
THE EXPERIMENT

Incidentally, there is no need for a 3-volt or a 6-volt battery, as the single cell works just as well. Don't worry about the significance of the word "volt" in describing a battery, as we will have more to say about this later.

In order to demonstrate the magnetic field around the wire very clearly we made up the apparatus shown in the photograph. It consists of a piece of board with a bolt and wing-nut at either end to hold the wire through which the current is to be passed. Arrange the wire so that it goes straight across the board at a slightly higher level than the home-made compass mounted on the needle. The electrical circuit will be completed by running a wire, one from each terminal on the board, to the opposite terminals of the battery.

Stand the board on the table with the compass needle under the wire. As you know, the compass needle will always turn to point north and south, so turn the board around so that the wire points in the same direction as the compass.

Wait until the pointer is perfectly still and then complete the electrical circuit by touching the wires on the terminals of the battery. The compass will move quite sharply and if you allow the current to flow for a few seconds will assume a position making a slight angle with the wire. Break the circuit and the compass will come back to its original position.



Representation of the magnetic field surrounding a coil of wire through which an electric current is passing.

PRACTICAL DEMONSTRAION

This is a visible demonstration of the magnetic field existing around a wire. There are other things we can learn about this field. For instance, try reversing the connections to the battery. Note that this time the pointer moves in the opposite direction. With the battery connections made as originally, bend the wire so that it passes below the pointer instead of above. Complete the circuit again and note that the pointer now moves in a direction opposite to the original.

These experiments indicate that the magnetic field surrounding a wire has a definite direction, and that direction depends on the direction of the flow of current through the wire. There are some rules of thumb by which the direction of the field can be determined, but, unless you wish to make a very detailed study of electromagnetism, there is nothing to be gained by learning them at the present moment.

The magnetic effect of an electric current is perhaps the most important single thing in electricity as far as on

(Continued on Page 83)

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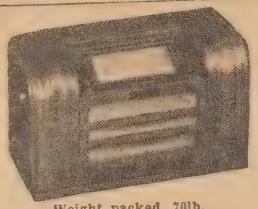

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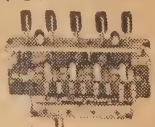

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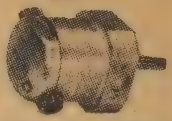

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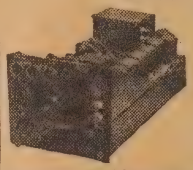

Complete with 11 valves; 2—R.F. stages, 954 acorns, mixer and oscillator, 2—955 acorns; 30 mcs, I.F. channel. 4—6AC7's; detector 6H6; cathode follower 6AC7; rectifier 5V4G.
Coaxial switching motors 24-volt D.C.
Frequency range, 160-190 mcs.
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We do not accept responsibility for any order damaged in transit.

THE UNIVERSE IN MINIATURE

(Continued from Page 81)

this effect directly depends most electrical machines. As a matter of fact, you can make a very elementary form of electric motor with the set-up we have just described.

Rather than leave the current flowing, as we originally suggested, try making the needle oscillate backwards and forwards by opening and closing the circuit. If you time the connections properly you will be able to make the oscillations bigger and bigger until eventually the pointer will turn right around. If you keep the pulses of current in time with the rotation of the pointer it will continue to turn around and around. The chances are that after a while it will turn so fast that you will not be able to keep time with it.

AUTOMATIC SWITCH

Of course the amount of power generated by this form of motor is very small indeed, and it would not be of much use to drive models, &c. but it illustrates a very important principle. The powerful and smoothly-running electric motors that drive our trams and trains are an elaboration of this simple idea.

Of course, the driver does not have to stand by with a switch to make the current flow in time with the rotation of the motor. The contacts to do this are inside the motor and are automatically opened and closed as required by the rotation of the motor itself. We will talk more about this later, when we come to building a practical working model of an electric motor.

Getting back to the field around the wire, it is possible to show the shape of this in much the same way as we demonstrated the field around a permanent magnet.

A very large battery, capable of delivering a great amount of current, is required to make a field strong enough to have a noticeable effect on the powdered iron.

We have prepared a diagram showing how the experiment can be done, and if you have access to a large storage battery you may like to try it. The amount of current flowing is very great and if allowed to flow for more than a fraction of a second will melt the wire, so be careful of burned fingers. Touch the wire with pliers only.

As the diagram shows, the field around the wire is circular in shape, being strong close to the wire and gradually becoming weaker farther away from the wire. However, if we run a number of wires parallel to one another, all carrying current in the same direction, we can make the field stronger and stronger. The more current flowing through the wires the stronger the field and the more wires the stronger the field also. So that if you want a magnetic field of a particular strength, you can make it by having few wires and high current, or many wires and a smaller amount of current.

Dozens of wires running parallel to one another will produce the required effect, but this is a very clumsy way of doing things, and the usual way of producing strong magnetic fields is to wind the wire in the form of a coil. The shape of the coil can be arranged to produce a magnetic field of any desired shape. For instance, a coil can be wound so that its magnetic field has the same shape as the bar magnet we studied earlier. We have prepared a diagram to show how the field from each part of the wire adds to produce the resultant field.

IRON CORE

It is possible to greatly increase the strength of the magnetic field surrounding a coil of wire by placing a bar of iron inside. The iron also becomes a magnet by induction and adds to the overall strength. As a matter of fact, most electromagnets designed for utilitarian purposes have iron cores and, in many cases, are completely iron clad.

Our major project in next month's experiments will be to construct a working model of a buzzer and one of the main parts is an electromagnet, which is constructed by winding a coil of copper wire around an iron core.

FROM THE SERVICEMAN WHO TELLS

(Continued from Page 69)

Strangely enough the owner had olerated this state of affairs for everal years and had finally decided o have something done about it only ecause he was tired of having to uggle controls to get the station he vanted. The fact that the distortion vas still, to me at least, intolerably igh, did not seem to worry him particularly, which only supports what have said on previous occasions, hat the average listener will tolerate he most deplorable performance rom his set for months before seekng technical advice.

As for the set itself, there is little nore to tell. I shifted the diode load onnection from the chassis to the athode of the 75, restored the AVC ondenser and removed the manual olume control. In place of the latter fitted a normal cathode resistor, naking it common to both the converter and IF valve and using the bypass condenser previously across the RF pot. Lastly, I fitted a tone control in place of the RF gain control, which apparently was what had been in that position originally.

After alignment the set put up a really worthwhile performance, in no way to be compared with the horrible noises which it had previously given worth. When I demonstrated it to the owner he was duly impressed, particularly when he discovered that he could switch over to the short wave band and actually hear short-wave stations!

I don't quiet know what the moral is in this story. I'm not quite sure whether it has one. I could say, "Don't fiddle with things you don't understand," but then if we didn't tackle a job we'd never learn.

MOULDS SAVES LIVES

(Continued from Page 13).

located penicillin, and Florey, who applied it to medicine, will be written for ever in the history of medical research.

Moulds are amazing substances. In the future we may be able to destroy harmful bacteria by the use of moulds that devour them wholesale, or by others that literally eat the harmful organisms out of house and home and so starve them to death.

The time will come when moulds will be watched and guarded with the greatest possible care. In the future rare and expensive chemicals may be manufactured cheaply with the help of moulds to carry out their synthesis.

With freedom for research Britain is prepared to carry on in peacetime with the great work she advanced during the war years; no less than the health and happiness of mankind.

FLUORESCENCE MODERN LIGHT

(Continued from Page 15)

caused by oxidisation of the rubber.

In medicine, a method has been evolved of tracing the blood by means of fluorescence.

A substance called uranin is injected into the bloodstream and after the average time of circulation has passed, the part of the body under observation shows a sharply defined yellowish-green fluorescence.

It is thus possible to determine whether a person has defective circulation. If the uranin is injected into the arm and the time noted for the fluorescence to appear in the lips it can be shown whether the circulation is faulty.

It follows that as the material is carried along in the blood there will be no fluorescence in parts where the circulation is hindered, thus it is possible to determine the site of a suspected blockage.

With proper treatment foodstuffs can be analysed for their vitamin content. The most widely used application in this respect is in regard to the vitamin B1 and B2 content.

To examine food for vitamins they are first treated to render the vitamin fluorescent, and then examined under an instrument called a fluorometer with suitable color filters. The fluorescent vitamin can then be observed.

A fluorescent material provides a ready means of detecting age in certain foodstuffs. For instance, fish show hardly any fluorescence immediately after killing, but fluoresce strongly when a day or two old.

Fractures in material show up strongly under fluorescence and can readily be detected. This is valuable in the examination of old pottery. The cement used to join pieces of pottery together, no matter how clever the job, can be detected by the difference in the fluorescence at the join.

Forgeries of stamps and banknotes are often detected by the difference in the fluorescence between the ink of the genuine and the ink of the forgery.

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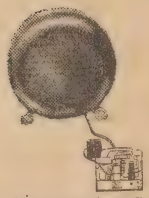

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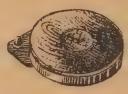

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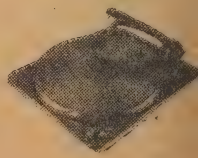

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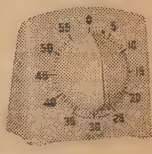

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ABOUT ENLARGERS AND ENLARGING

Last month we discussed some of the reasons why enlargement of most negatives is desirable, this being a kind of introduction to the whole subject of enlarging. We hope to make it our theme for the next few articles. This month we discuss some aspects of the enlarger proper.

by Philip Watson

N addition to the purely physical aspects of enlarging, such as we scussed last month, there is the sthetic side still to be considered, at is, how the enlarger can be used make a better presentation of your cture.

For the time being let us stick to e mechanics of the process, for it no use worrying about the finer ctorial points until we have astered the art of making a technicy perfect print.

First step in this direction is to derstand thoroughly the operation the enlarger. Such a discussion ould serve as a guide for anyone ntemplating the purchase of one, as ll as for those who may prefer make their own. Later we may able to publish some details for me constructors but first let us nsider what we should expect it do and how the results are norlly achieved.

SIC PRINCIPLES

Most of you are no doubt familiar h the basic principle of enlarging, it is simply that of projection. member how the tiny images of a tion picture film are enlarged so t they fill a large screen. When a ative image is so projected, we y substitute a piece of sensitised er for the screen and produce an arged print.

First requirement in any proor is a source of light and, alugh daylight, oil lamps and gas nes have all been used at one e or another by far the most ular source today is the filament p, with a growing interest in the rescent types which offer a numof advantages.

Whatever the source, however, we t distribute the light so that ry part of the negative receives same amount or, in other words, evenly illuminated. There are eral ways in which this can be e. The light may be diffused, it be reflected in a form of inct lighting, it may be condensed, t may be subject to a combinaof two or more of these systems.

FUSED LIGHT

et us take them in order. Difd light is obtained by inserting ranslucent material, such as nd glass, between the light and negative. This causes the light catter and the clear outlines of ight source are no longer visible, what was a small area of light appears much larger, although intense and, if this idea is carfar enough, the whole area of negative can be evenly illumid.

ually a single sheet of ground in conjunction with a flashed globe will give sufficient difn for most ordinary sized nega, but the results can be improved by the use of a concave mirror behind the light so that some of the rays which would otherwise be wasted are also concentrated on the negative, preferably where the direct rays are weakest.

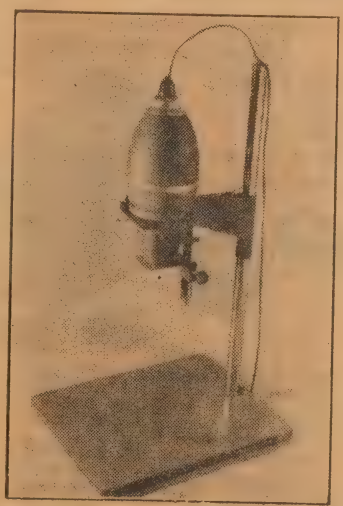
The main advantages of this system are simplicity, low cost and absence of critical adjustments. On the other hand, it has the disadvantage of low light efficiency, a great deal of light being wasted in the process of diffusion. This means that exposures will be longer for a given size of lamp which, in turn, means more heat generated in the lamphouse. With dense negatives and big enlargements there is a consequent risk of damage to the negative.

It also becomes more difficult to design a lamphouse with adequate ventilation which is still light tight.

As well as wasting light, this system produces a lower contrast print than any other type, so that negatives intended for this type of enlarger really require longer development or may need a more contrasty grade of paper. Either of these schemes introduces problems of its own, of which we will have more to say later.

In spite of the above defects, the diffused light system is very popular in low-cost enlargers, while some more elaborate types are designed so that diffusion may be deliberately introduced when it is desired to reduce the contrast of a particular negative.

Condenser lighting employs a more accurately designed optical system which wastes much less light but is rather critical in adjustment, if maximum benefit is to be obtained from it. It also has the property of producing an apparently greater contrast in the projected image than is present in the negative and the resulting greater contrast in the print can be alternatively convenient or embarrassing.



This is a typical example of low priced enlargers at present available on the Australian market. Without lens this model sells at just under £15. Using diffused light it can be readily fitted with a condenser for semi-diffused lighting. Takes all sizes up to 2¼" x 3¼".

CONDENSED LIGHT

Such a system employs a point source of light, a reflector, and a condenser unit consisting of two condenser elements. A condenser element is normally a simple lens, being curved on one side and flat on the other. It is known as a "plano-convex" element. When two such elements are used together, they are mounted with the curved surfaces facing one another. The so-called point source of light would be a clear globe with small filament area.

The light rays radiate from this source almost equally in all directions. Some fall on the walls of the lamphouse and are wasted but those which fall on the condenser are bent and, according to the adjustment of the system, may be made to emerge parallel or converging as required. Those going toward the rear of the lamphouse will be collected by the reflector and also directed to the condenser.

CONDENSER ACTION

The action of the condenser is to cause the light rays to emerge from the opposite side equally at all points and a negative, if placed in front of it, will be evenly illuminated.

It is important that the light rays emerging from the condenser be made to converge slightly in order that all of them may be able to pass through the lens and none be wasted.

To bring about this condition it is necessary to adjust the distance between the lamp and the condenser and also the lamp and the reflector, the exact adjustment depending on the distance from the lens to the condenser. This distance will vary, however, for varying degrees of en-

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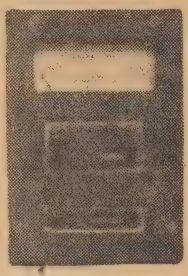

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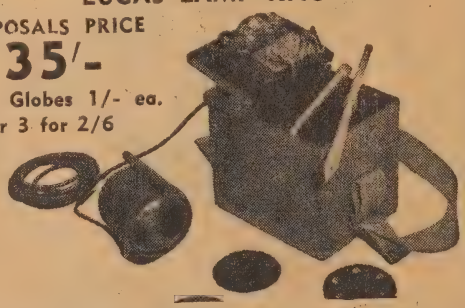

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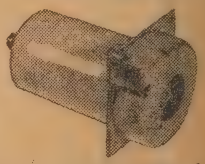

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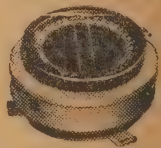

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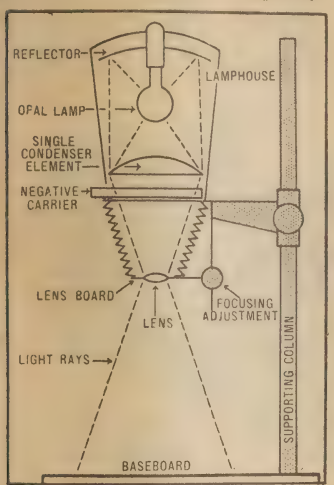
largement and, for optimum conditions, there are several adjustments to be made every time the degree of enlargement is altered.

Quite naturally, this is time-consuming and, in practice, some kind of a compromise adjustment is usually adopted.

INCREASED CONTRAST

It was mentioned earlier that the use of a condenser lighting system causes an increase in contrast. This is mainly due to the scattering effect on the light rays by the dense portions of the negative. Little or no scatter occurs in the thin parts of the negative and the light is transmitted with maximum efficiency, so that the thin portions are printed by condensed light and the dense portions by diffused light, giving an effective increase in contrast.

This means that negative development times can be kept short and the negative will still yield a satisfactory print on a normal grade of paper, a feature which is very helpful in keeping grain at a minimum. However, boosting the contrast of the negative in this way also boosts the contrast of specks of dust, faint abrasions on the negative, &c. These may become unpleasantly prominent, whereas they might not be noticed, if printed by diffused light.



This drawing shows the component parts and usual setup of a modern enlarger. The dotted light lines show the path of the light rays which ideally should converge on the lens as shown. With semi-diffused lighting this is seldom achieved but the system is popular for other reasons.

The result of all these conflicting factors is that a compromise has been adopted which embodies as nearly as possible the advantages of both systems, while keeping their bad points to a minimum. This is known as the "semi-diffused" system and usually consists of a flashed opal globe, a reflector, and a single condenser element. It is reasonably efficient optically, does not require any adjustments for varying degrees of enlargement, and gives a degree of contrast intermediate between that of diffused light and condensed light.

It is by far the most popular system in use today and nearly all commercially available enlargers employ it, with the exception of a few of the cheapest models.

Another problem of illumination is that of stray light, for it is necessary to provide considerable ventilation in a lamphouse and at the same time prevent light from escaping which will fog the printing paper. The usual approach is the use of light traps, which assume that light will not go around corners. These often leave much to be desired, however, and it may be necessary to cover the lamphouse with an opaque cloth during the actual period of exposure.

When considering the design of an enlarger, it is well to take into account the largest negative which the condenser will cover.

DIAMETER

To cover a particular size of negative, a condenser needs to have a diameter at least equal to the diagonal of the negative, or, preferably, a little larger, since rays of light converge as they emerge from the condenser and will only cover that size negative if the two are very close together. In practice this is hard to achieve, so that there is a small loss in covering power.

Many prefer an enlarger which will accommodate larger negatives than their normal size, particularly if this is one of the smaller sizes, so that a greater variety of work can be undertaken.

In the case of the semi-diffused lighting system it is usually quite satisfactory as the adjustments are not critical but, with a condenser system, it is possible to run into extreme conditions where the rays from a long focal length condenser cannot converge to suit a short focal length lens and a lot of light is wasted.

Quite apart from the covering power, however, it is desirable that the negative carrier be able to accommodate larger negatives in order that portions of them may be enlarged.

The negative carrier is normally found in two forms, that in which the negative is held between two pieces of glass, and the "glassless" type in which it is held between two metal plates having suitable apertures punched in them.

The glass plates will hold a negative absolutely flat but they have the disadvantage of presenting four more surfaces which can collect dust, quite apart from the negative itself. Furthermore, any attempt to clean glass usually results in the formation of a static charge, so that more dust particles are attracted.

On the other hand, the "glass-

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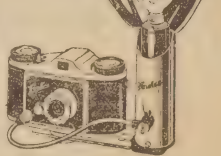

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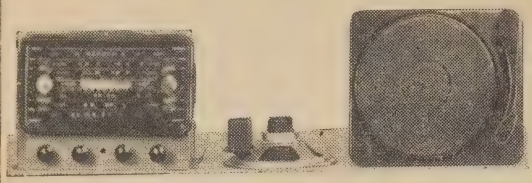

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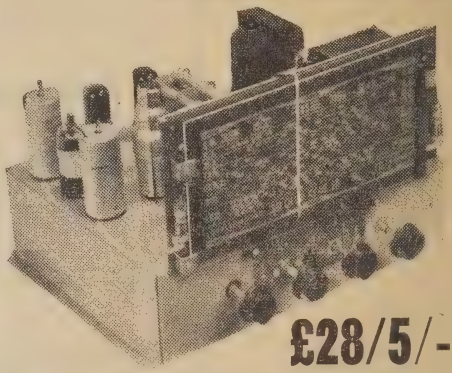

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less" type, while minimising dust, does not always keep a negative perfectly flat, although this defect is mainly noticeable only when large areas are involved. Prolonged exposures which subject the negative to considerable heat will often cause it to buckle if it is not properly held and glass plates may then be the only solution.

In general, the glassless type is to be preferred when condensed light is used but hardly seems to be necessary with diffused light. In any case, it is not a particularly difficult job to fit a glassless holder to any enlarger already fitted with glasses.

Before leaving the subject of negative holders it may be as well to mention the matter of negative masking. When only a small area of negative is to be enlarged it is necessary to mask off the unwanted portion, otherwise a large area of light will be projected, and, by being reflected from nearby walls, &c., back on to the paper, can cause fog.

MASKING

Higher-priced models have adjustable masks built in while the cheaper models usually rely on a selection of fixed sizes which can be inserted as required. While the former is more convenient, the latter can be quite satisfactory if a large enough selection in masks is available.

Next we come to the lens, which is really the heart of the enlarger, for really first-class results cannot be obtained unless this is of first quality. The ideal is an anastigmat, specially corrected for enlarging work and of the best quality you can afford.

The correction for enlarging implies that the various corrections which are built into the design of a lens, and which are for the most part compromises, have been worked out on the basis of the relatively short distances which are involved when enlarging. This is in contrast to the longer distances which are normal with a camera lens and for which it would normally be designed.

This should not be taken as implying that a camera lens is unsuitable for use in an enlarger, for the difference is not very great but it does mean that, when purchasing a new lens, it is better to get one designed for the job. There is no objection to using your camera lens, except that it may not always be convenient.

BACK REMOVED

In some cases it is possible to use the camera with the back removed, thus providing bellows and focusing mechanism, as well as the lens, all in the one unit. Naturally this restricts the availability of the enlarger to those times when the camera is empty, which may not always be convenient.

More modern styles of cameras with self-erecting fronts are not very satisfactory, as the available focusing range is insufficient. In some cases it may be possible to remove the lens without too much trouble, and it can then be mounted on a small plate designed to fit the enlarger.

Cameras with focal plane shutters are normally designed so that the lens may be easily removed as this is one of the features of this type of camera. Furthermore, the film is protected by the shutter so that the lens may be used at any time when the camera is not actually in use.

When considering a lens purely for use in an enlarger it is not necessary to have the large apertures which are normally associated with camera lenses.

Although most enlarging lenses are available in apertures of f 4.5, they are seldom required to work at anything like this size and are usually found stopped down to around f 11 or f 16. Even with dense negatives and six or seven diameters of enlargement the exposure is only a few seconds with a 75-watt lamp. A 150-watt lamp can make exposures embarrassingly short at moderate degrees of enlargement.

SMALL APERTURE

On the other hand, too small a maximum aperture can make focusing very difficult and it is handy to be able to "open up" for focusing and then stop down for the actual exposure. Even so maximum apertures of f 6.3 or f 8 would appear to be quite satisfactory, particularly if the saving in cost can be directed toward a better-quality lens.

From what has just been said it is fairly obvious that a diaphragm is essential if exposure is to keep within reasonable limits over a wide range of negative densities and degrees of enlargement. The use of a smaller stop also helps to mask any small errors in focusing, as well as providing a depth of focus in the event of special effects requiring the paper to be tilted.

The diaphragm markings should be clearly visible on the side of the lens mount, for it is almost impossible to read them on the front without standing on one's head. Better still is the clicking diaphragm which is becoming popular on lenses intended for enlarging and which enables the lens to be set by feel, simply by counting the number of clicks from the full open or full closed position.

The focal length of the lens should be selected with regard to the size of negative, normal procedure being to use the shortest length which will completely cover the negative. Common sizes are 2in for 35 mm, 3in for 127 or 2¼in x 2¼in, and 4¼in for 2¼in. x 3¼in. The use of longer focal length than is necessary restricts the degree of enlargement for a given height of column, as well as reducing the resolving power of the enlarger.

To understand the latter point it is necessary to realise that the resolving power of a lens is calculated as being the ability to separately resolve a certain number of lines spread over a distance equal to the focal length. Thus a long focal length and a short focal lens would both resolve the same number of lines per maximum covering area, or per picture, rather than per inch. This puts a 6in lens at a disadvantage when it is called upon to enlarge a 35 mm frame.

A worthwhile feature in any enlarger is the ability to change lenses, if they are available, without a great deal of effort.

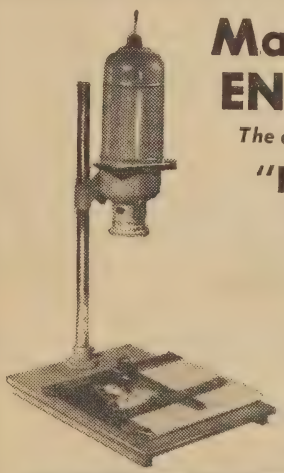
With the lens goes the focusing mechanism, which is simply some means whereby the distance from the lens to the negative may be varied. In many cases the form which this takes leaves much to be desired.

FOCUSING MECHANISM

Where a worm and pinion drive is employed it is essential that the two parts be accurately cut if they are to mesh freely without backlash and without the need for undue pressure. Backlash makes accurate focusing very difficult. Where a friction drive is employed, the backlash fault is usually eliminated but there is always a chance that wear will cause trouble at a later date, unless the unit is well designed in the first place.

In this regard much depends on

(Continued on Page 101)



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SHORT WAVE NOTES BY RAY SIMPSON

JAPANESE SHORT WAVE STATIONS

Prior to the war the Japanese short wave stations were heard at very good strength in Eastern Australia and we especially remember the one on 11.8 mc which was always very loud. Since the war however, these stations have not been nearly so consistent and except on rare occasions are not received at real entertainment level.

ACTUALLY, the Japanese stations are now in two groups, those which are under the control of the Armed Forces Radio Services and those that are operated by the Japanese Broadcasting Corporation or, to give it its local name, Nippon Hoso Kyokai.

From the Universalite we gather the following information regarding the NHK stations, and we think it will be of interest to our listeners who may have been puzzled by some of the transmissions. As it was obtained direct from the station, it is the latest information available.

At the present time all medium-wave transmissions are meant for inter-station communication in Japan as well as for the benefit of all Japanese nationals in the Far East. Short-wave transmissions are intended for overseas reception and no other language than Japanese is used.

1st Transmission Relay and Communication for Domestic Service:

Yamata, JHK, 7.257 mc, 5000 watts, 5.25 am to 11.0 pm.

Nazaki, JKI, 4.91 mc, 5000 watts, 5.25 am to 7.15 am and 7.25 pm to 11.0 pm.

Nazaki, JKI2, 9.655 mc, 5000 watts, 7.25 am to 7.15 pm.

2nd Transmission Relay for Domestic Service:

Nazaki, JKJ, 7.285 mc, 5000 watts, 5.25 am to 11.0 pm.

Kawachi, JKM, 4.94 mc, 5000 watts, 5.25 am to 7.15 am and 7.10 pm to 11.0 pm.

Kawachi, JKM2, 9.695 mc, 5000 watts, 7.25 am to 7.0 pm.

Far Eastern Service:

Kawachi, JBD, 9.505 mc, 7500 watts, 7.25 pm to 12.0 am.

Kawachi, JBD2, 9.56 mc, 5000 watts, 7.25 pm to 12.0 am.

Kawachi, JBD3, 15.225mc, 7500 watts, 7.50 am to 7.15 pm.

Kawachi, JBD4, 15.235 mc, 5000 watts, noon to 7.15 pm.

Kawachi, JKI4, 11.8 mc, 5000 watts, 7.50 am to 11.45 am.

They state in their letter that JKI, 4.91 mc, JBD2 and JKI4, the latter two operating on 9.56 mc and 11.8 mc respectively, are subject to change in transmission times as given above. Station JKI4 on 11.8 mc is a new frequency, though no mention was made as to when it began operations. Their address is Nippon Hoso Kyokai, Broadcasting Corporation of Japan, Radio Tokio Building, Tokio, Japan. Mr. Isamu Yamazaki is Chief of the International Broadcasting Section. The NHK state that there is no immediate prospect of resuming the International Service in English or other languages. Despite the above remark from the station, we learn from another source that following the signing of the Peace Treaty it is thought that broadcasts to overseas will be resumed. This latter information came to us through the New Zealand DX Times.

A VERIFICATION FROM GUATEMALA

TWO interesting verifications have been received recently by our New Zealand friend, Art Cushen, the first being a card from TGNA in Guatemala confirming his reception on 5.952 mc. The card shows a picture of the Quetzak bird and gives details of the station, which show frequencies to be 1180 kc, 9.668 mc, and 11.85 mc, with 15.1 mc and 17.87 mc to be used later. The station, which has a power of 5 kw, is a missionary one financed by voluntary contributions, and broadcasts in Spanish from 10.30 pm to midnight and 8.30 am to 1.0 pm, and in English from 1.0 pm to 1.30 pm.

The second was a letter from Mr. Fred G. Taylor, Director of RIAS in Berlin, confirming reception of their station on 6.005 mc. They stated that they commenced regular broadcasts on August 7th and thanked Art for his report of August 6th when they were testing. Their power is 20 kw and schedule 1.45 pm to 5.45 pm and 7.0 pm to 11.05 am. On Mondays they remain on the air until 11.30 am. Address is RIAS, Kufsteiner Strasse 69, Berlin-Schoneburg, Germany.

The Irak Broadcasting Station in Baghdad, Irak, now operates on 11.724 mc from 2.30 pm to 4.0 pm, 7.30 pm to 9.0 pm, and 11.30 pm to 6.0 am. They use 16 kw and request reports on their English program at 3.15 am. The new station, Radio Atlantico, in Fernando Po, is reported to be testing on low power on 7.2 mc from 4.30 pm to 5.30 pm, 10.0 pm to midnight, and 3.0 am to 5.0 am. The high power station is expected to take the air on December 5.

SHORT WAVE NOTES for the January issue are due on December 8. For the February issue they are due on January 5. Please send them direct to Mr. Ray Simpson, 80 Wilga St., Concord West, N.S.W.

STATION ADDRESSES

HVJ	State Citta del Vaticano, Stazione Radio Roma, Vatican City.
EAR	Radio Falange de Valladolid, Santiago 2, Valladolid, Spain.
CSB52	Radio Renascenca, Emissora Catolica Portuguesa, Rua Capelo 5, Lisbon, Portugal.
ELBI	Liberian Broadcasting Company, Monrovia, Liberia.
CNR3	Radio Maroc, Immeuble des P.T.T., Rabat, Morocco.
PJC2	Curom, P.O. Box 31, Willemstad, Curacao.
FG8HA	Radio Diffusion Francais Prefecture, Basse-Terre, Guadeloupe.
HIIZ	La Voz de la Muchachos, Apartdo 1092, Ciudad Trujillo, Dominican Republic.
ZQ1	Radio Jamaica, Broadcasting House, Cross Roads P.O., Jamaica, B.W.I.
OAX4L	Radio Miraflores, Pardo 769, Lima, Peru.
CXA8	Radio Real de San Carlos, Flores 30, Colonia, Uruguay.

FLASHES FROM EVERYWHERE

EGYPT: This country has been in the news of late in connection with the Anglo-Egyptian Treaty and it would seem that there may be quite an amount of trouble before the situation is settled. Shortwave reception from Egypt has never been very satisfactory in this country, but it should be possible to hear SUV on 9.985 mc when they broadcast an English session from 2.45 am to 3.0 am.

This programme opens with the Toreador Song from the opera Carmen. This is followed by a news commentary and request numbers. The station reopens at 3.30 am with a programme in French, and finally leaves the air around 6.0 am.

BRAZIL: There are quite a large number of short-wave stations in this South American country, and we now hear through Radio Australia that a new one, known as "Radio Borborema," has opened on 3.325 mc and is on the air from 10.0 am to noon and sometimes from 1.0 pm to 3.0 pm.

They transmit with a power of 1000 watts, and their address is Rua Cardosa, Vieira 36, Campina Grande, Parnaiba. PRF6 "Radio Bare," 4.895 mc, located in Manaus, Amazons, have been testing their new 5000-watt transmitter around 1.0 pm. The Sao Paulo station, PRB21 on 6.055 mc, PRB22 on 9.505 mc, and URB23 on 15.135 mc. PRB22 can be heard on occasions, but it is rather difficult to separate from nearby stations.

SWITZERLAND: The Swiss stations have always been very popular in Australia and in their session to Australia are usually heard at excellent strength. We now learn that the Swiss Broadcasting Corporation will be broadcasting a DX programme in English on the first Wednesday of each month at 5.20 am, and repeated at 12.05 pm, 1.30 pm, 5.50 pm, 7.35 pm, 11.20 pm, and also on the Thursday morning at 1.20 and 3.20 o'clock.

We have noticed that HER8, on 21.52 mc, has again been in use around 10.0 pm, though strength at our location has been far from good, with a considerable amount of fading. The SBC would like reports on the above-mentioned DX programmes; send them to the SBC at Neuengasse 28, Berne.

USA: Many of our more junior short-wave listeners derive a lot of pleasure in tuning in the many American stations as they are at good strength and also easy to identify. Verifications from these stations have in many cases been the start of some very interesting collections as they usually include some of the colorful cards from amateurs.

In this regard these listeners will be interested in the latest schedule for the Radio Amateur Programmes, which are as follows: Sunday, Latin-American Service, 12.30 pm on 9.67mc, 11.89 mc, 15.21 mc, 15.35 mc and 17.83 mc. Far East and Pacific Service, Monday at 12.45 am on 6.06 mc, 6.12 mc, 9.515 mc, 9.57 mc, 9.6 mc, 11.73 mc, 11.79 mc, 11.89 mc, 15.25 mc and 15.33 mc. European Service, Monday, 5.15 am, 7.2, 9.7, 11.87, 12.095, 15.27, 17.78, 21.5 mc.

PHILIPPINES: We are indebted to Graham Hutchins' DX session from Radio Australia for some interesting details regarding the well-known stations of the Far East Broadcasting Company in Manila. As readers are aware, DZH6 on 6.03 mc, DZH7 on 9.73 mc, and, more recently, DZH8 on 15.3 mc, have been heard at quite good strength for many months. There have been various reports that they were going to take into use their 25-metre outlet but it has not yet eventuated.

However, it now appears from the latest information from the station that they expect their new 2 kw station to be ready for operation in November and the frequency to be used 11.85 mc. This station makes it easy for listeners to identify, as they announce their call-signs and frequencies every half-hour and sometimes each quarter-hour.

THE HAM BANDS WITH BILL MOORE

The Jubilee VK/ZL DX contest, 1951, left many pleasant memories in the minds of participants, but old man QRN also left a lasting impression on the ears of the competitors, especially on those who took the contest seriously and ventured on the 3.5 and 7 MC/S bands.

QRN was at its worst during the CW section of the contest and was particularly bad in the eastern Sttaes. Conditions generally were only fair during both sections of the contest, but certainly some improvement over recent months.

Contest committee chairman Wal Ryan (VK2T1) was pleased to see the contest so well supported. It was some reward for the tremendous amount of work put into the event by the contest committee. A record number of logs should be received. Choice DX appeared at various times and from 9S4's to ZD7's the entrants could be heard selecting the better stations. Multipliers close to the century were amassed by some competitors.

During the telephony section terrific interference was experienced by VK stations from NZ entrants, and undoubtedly the reverse was also noticed. Commercial stations on the 7Mc band rendered a considerable portion of the CW section 7000-7050Kc's unworkable.

CONDITIONS

Some competitors expressed the opinion that not so many G and W stations were active as in previous contests; perhaps the poorer conditions was a contributing factor. The leading scorer in NSW averaged a contact every six minutes over the full 24 hours, so there must have been a good selection of stations operating.

A number of competitors operated in excess of the 24-hour period set down. This appears to be a minor breach of the rules, but more important is the fact that such operation increases QRM — a bad enough problem at any time — and should be discouraged.

Congratulations to the Tasmanian Division on winning the 1951 Remembrance Day contest, their third consecutive success. The winning divisional team comprised VK7LJ, 7AJ, 7RX, 7BH, 7NC and 7JB.

An analysis of the results discloses very many interesting facts. Again a small State won the trophy, but on this occasion NSW ran second, the first time one of the larger States has filled second place since the rules were altered. VK4 ran third. The average for the six leading stations in Tasmania was 447 points for the first six in NSW 572 points. The bonus added to the mentioned averages to obtain the final score was 240 for VK7 and 46 for VK2—this bonus depending on the stations active in the State. 50 out of a total of 93 stations were entrants in Tasmania.

SCORING SYSTEM

If the contest result is to be a reflection of operating skill, then the system of scoring must be radically altered. The magnificent operating effort of the six leading stations in NSW, VK2ZC, 2DO, 2WH, 2AMR, 2AMV and 2PA (all from country areas) was of no avail and bonus adjustment ruled the State from any hope of winning. If it is intended that operating is not a feature and the percentage of stations operating be more important, then serious participation by stations in the larger States will surely lag.

By virtue of one fact alone, that of interference, stations in the larger States often restrict their operation to one band. This is very evident around the major cities. Some keep to the 7Mc band, others never leave 28Mc, while the UHF gang are a group on their own.

It is tremendously difficult to obtain the same interest in any contest in any of the larger States compared with smaller States. In Tasmania, if you managed to get 47 stations active in a contest, you would have to get 545 stations operating in NSW to obtain the same percentage competing.

Imagine the state of the bands around Sydney with about 400 stations operating —it would frighten most of us for all time from contests.

The leading station in Australia was Jack Rumble (VK6RU) 664 points, second Jim Cowan (VK2ZC) 624 points, and third Roy Reyner 613 points — the only stations to score over the 600 mark. 67 more stations competing than in 1950.

SILENT KEY

IT is with deep regret we record the passing of a much-loved NSW amateur —Warne (Bluey) Crammond (VK2KJ) of Lane Cove, on September 28. Active since 1928, Blue could mainly be heard on CW on the 14Mc band, where he yarned at length with many DX stations. In recent years VK2KJ was not so active, but his signal could always be recognised by its characteristic swing. His work with the PMG's Department often took him out west and reflected on his activity.

During the existence of the Lane Cove Radio Club, Blue tutored many newcomers in the hobby and during the war years was very active in the Signals Section of the VDC. He was a member of the WIA for more than 20 years.

ROSS A. HULL MEMORIAL VHF CONTEST

THE WIA's annual 50Mc contest will be run in December and January, and should be well supported. The band opened in late October as usual for interstate working, and by December the summer DX season should be in full swing.

Rules of the contest are as follow:

(1) The contest will take place in the 50-54Mc and will commence at 0001 hours EAST on December 15 and will continue until 2359 hours EAST on January 6, 1952.

(2) Points may be claimed for contacts outside the competitor's own call area.

(3) Only one contact with any one station per 24 hours, commencing midnight EAST to count as a scoring contact.

(4) Exchange of a serial number will constitute a contact.

(5) The serial number of five or six figures will be made up of the RS (Telephony) or RST (Telegraphy) reports, plus three figures which may commence with any number between 001 and 100 for the first contact and which may increase in value by one for each successive contact; eg, if the number for the first contact is 050, then the number for the second contact must be 051, and so on. If any contestant reaches 999, then he will start again 001 and continue.

(6) Scores will be calculated on a points basis as shown below.

(7) Logs should contain the following information: Date, time (EAST), call of station contacted, serial number sent, serial number received, points claimed for the contact, and at the foot of each page, total points claimed, and at the end the grand total.

Logs should be signed by the competitor together with a declaration to the effect that the station was operated strictly in accordance with rules and spirit of the contest. The decision of the committee shall be final and binding. Logs must be received by the Jubilee Federal Contest Committee, Box 1734, GPO, Sydney, not later than February 27, 1952.

(8) Entries will be accepted from all States of the Commonwealth and districts of New Zealand. Check logs from other countries will be appreciated by the contest committee.

(9) For the purposes of scoring, Northern Territory will count as a separate call area. Also, VK9 will be considered as a State of the Commonwealth.

(10) The decision of the contest committee will be final and binding upon all matters pertaining to the contest.

(11) the regulations governing the control of amateur radio in each contestant's country must be observed.

(12) Awards: The outright winner of the contest within the Commonwealth of Australia will hold the Ross A. Hull Memorial Trophy for one year and will in addition receive an appropriately inscribed certificate.

The highest scorer in each call area in Australia and New Zealand will be awarded a certificate. In addition, the contest committee will have the right to make any other additional awards as entries or any other individual performance may warrant.

Scoring: Varied number of points are awarded for contacts with different call areas. These are as follow:

VK2 to VK3, VK4 and VK5, 2 points; VK6, 10; VK7, 4; N.T., 6; VK9, 10; ZL1, 2, 3, 4, 7; and other countries, 20 points.

VK3 to VK2, 2; VK4, 4; VK5, 2; VK6, 9; VK7, 2; N.T., 6; VK9, 11; ZL1, 2, 3, 4, 7; other countries, 20 points.

VK4 to VK2, 2; VK3, 4; VK5, 5; VK6, 11; VK7, 7; N.T., 3; VK9, 7; ZL1, 7; ZL2, 3, 4, 8; other countries, 20 points.

VK5 to VK2, 2; VK3, 2; VK4, 5; VK6, 7; VK7, 2; N.T., 3; VK9, 10; ZL1, 2, 3, 4, 8; other countries, 20 points.

VK6 to VK2, 10; VK3, 9; VK4, 11; VK5, 7; VK7, 10; N.T., 12; VK9, 14; ZL1, 2, 3, 4, 17; other countries, 20 points.

VK7 to VK2, 4; VK3, 2; VK4, 7; VK5, 2; VK6, 10; N.T., 7; VK9, 12; ZL1, 2, 3, 4, 7; other countries, 20 points.

N.T. to VK2, 6; VK3, 6; VK4, 3; VK5, 3; VK6, 12; VK7, 7; VK9, 3; ZL1, 2, 3, 4, 15; other countries, 20 points.

VK9 to VK2, 10; VK3, 11; VK4, 7; VK5, 10; VK6, 14; VK7, 12; N.T., 3; ZL1, 12; ZL2, 13; ZL3, 14; ZL4, 15; other countries, 20 points.

ZL1 to VK2, 7; VK3, 7; VK4, 7; VK5, 8; VK6, 17; VK7, 7; N.T., 15; VK9, 12; ZL2, 4; ZL3, 2; ZL4, 3; other countries, 20 points.

ZL2 to VK2, 7; VK3, 7; VK4, 8; VK5, 8; VK6, 17; VK7, 7; N.T., 15; VK9, 13; ZL1, 4; ZL3, 4; ZL4, 3; other countries, 20 points.

ZL3 to VK2, 7; VK3, 7; VK4, 8; VK5, 8; VK6, 17; VK7, 7; N.T., 15; VK9, 14; ZL1, 2; ZL2, 4; ZL4, 4; other countries, 20 points.

ZL4 to VK2, 7; VK3, 7; VK4, 8; VK5, 8; VK6, 17; VK7, 7; N.T., 15; VK9, 15; ZL1, 3; ZL2, 3; ZL3, 4; other countries, 20 points.

Another contest will be run during December. It is the fifth all-European DX contest and is staged this year by the RSGB as a part of the Festival celebrations. There are two weekends, each of 48 hours, one CW, one Telephony.

The CW portion commences at 0001 GMT on Saturday, December 1, concluding at 2400 GMT on Sunday, December 2; the Telephony section between similar hours on the following weekend, December 8 and 9.

Serial numbers to be exchanged are the signal report plus a selected three-figure group (five figures Telephony, six figures CW). Logs to the RSGB.

EUROPEAN DX CONTEST

VISITOR to Australia has been VS7JA Jim Amarturge who is secretary to Ceylon's Minister of Agriculture, a member of the delegation that accompanied the Prime Minister on his recent tour of the Commonwealth. VS7JA saw quite a number of the VK gang and attended a VK4 WIA meeting. Jim was going to attend the NSW meeting but left for Ceylon on that evening.

VK2QV is the call-sign of newcomer Percy Sara, father of the Bellingen quads. The Q in the call stands for the quads, the V according to North Coast zone officer Noel Hanson, VK2AHH, is the Roman five—we wouldn't wish it on you Perc.

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Initial appointments will be to Sydney Radio, but officers may later be required to serve at northern stations. District allowances at non-metropolitan stations vary between £15 and £175 per annum and are additional to salary. Penalty rates are paid for shift work, week-end and holiday duty. There are staff cottages at Papua-New Guinea stations and non-metropolitan stations in Australia.

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national zone is apparently KTI—KTIOC gave his QTH as in the zone.

WIATE and WIARV are on the lookout for Australian contacts on 3.5 mc. They report hearing a number of VK stations. The former uses a half wave vertical on the band—it must be an impressive affair with 130ft of wire hanging vertically.

The intense 144 mc operation in country areas in NSW must soon pay dividends in opening the band for extended ground wave and refracted working.

Recently VK2XO, of Raleigh, on the coast, was heard by VK2APS and VK2AIR, of Tamworth, over a path of 140 miles. The path covered is an extremely difficult one with the main Dividing Range interposing.

The Tamworth gang were using an SCR522 receiver while 2XO used PP7193's and a three over three beam (elements gold plated!). Signals were not very strong but with further experimenting the path may be a permanent one, however some tropospheric bending may have been present on the day, as 2XO also heard a signal arriving from the south.

Also on the North Coast, VK2AWG from Coffs Harbor, VK2AHH from Kempsey, VK2AEY Taree, and VK2PA are active. In Inverell VK2UN and VK2ATS are operating while in the west a considerable number of stations are active.

VK2JW, of Orange, is experimenting with pulse transmission and has been heard in Forbes. Operating portable from Mt. Canobolas with 1.25 watts input he contacted VK2WH, of Forbes, and heard VK2NS, of Bathurst. The latter is endeavoring to break through to Sydney from his home QTH in Bathurst. Some months ago Harry Lapthorne, VK2HL, contacted Sydney from just outside Bathurst on Mt. Panorama. VK2EI at Parkes is on 144 as are VK2AMV and VK2WH, of Forbes.

If the experiences in America and Europe are repeated, the additional population of the band should produce interesting contacts if stabilised transmitter, effective receivers and stacked arrays are used.

In early November, VK2NS at Bathurst conducted tests with VK2ANF and VK2MQ in Sydney, signals were heard both ways although only weakly. It is expected that a practically permanent link will be established after further experimenting. In Southern NSW VK2PM in Canberra and VK2DO in Yass are also operating on 144 mc.

ZL2ACB in Wellington is contacting ZL3LE in Christchurch almost nightly on 144 mc over a path of nearly 200 miles. They have co-related the openings with the weather. Daily forecasts from the weather office allows ZL2ACB to fairly closely predict whether contact will be possible.

Leo, ZL2VR, also reports that the 3.5 mc band is providing good openings to North and South America, KH6 and Europe, signals often running up to the S6 mark.

WIA NEWS

PROFESSOR D. G. MEYER, of the Department of Electrical Engineering, Sydney University, lectured at the October meeting of the NSW Division, his subject "Electronic Computers." The professor covered fully the history of two main types of computers plus their development.

He pointed out that problems, that would take years to solve by normal methods, could be solved in a matter of weeks by means of computers. Although the subject was rather removed from the normal type of lecture, those present appreciated the discourse and the professor's antidotes.

A considerable amount of discussion has recently taken place concerning higher power for amateur stations.

It is just on five years ago since amateur stations were granted their last power increase to 100 watts, and with improved techniques there seems to be no reason why BCI would be any problem with 250 watts.

A power increase would make a tremendous difference to communication on the UHF's where extended ground wave work is important. It would also assist on the lower frequency bands with conditions as poor as they are at the moment.

It is certain that in the next few months amateurs will be considering whether they should apply for a power increase.

Incidently both Fred Martin, ZL1FS, and Leo Johnson, ZL2VR, point out that the reference in the October issue to 250 watts as the permitted input for ZL stations is in error. Allowable input is 100 watts.

A.O.C.P. CLASS

The Victorian Division A.O.C.P. Class will commence on Thursday, 17th January, 1952. Lectures are held on Monday and Thursday evenings from 8 to 10 pm. Persons desirous of being enrolled should communicate with the Secretary, W.I.A., Victoria Division, 191 Queen Street, Melbourne (Phone FJ6997, from 10 a.m. to 4 p.m.), or the Class Manager on either of the above evenings.

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2. Define the following:—(a) mutual conductance, (b) A.C. plate resistance, (c) amplification factor, (d) secondary emission.
3. A capacitor of 4 microfarads, connected across a 50 cycle supply, has a reactance of 796 ohms. What would be the reactance if the capacity was changed to 2 microfarads?
4. What, in meters per second, is the nominal speed at which radio waves travel?
5. What is the wave-length in meters of a signal frequency of 4 megacycles?
6. If a 6-megacycle transmitter increases frequency by 0.02%, what is the frequency increase in cycles?
7. If two coils, each having an inductance of 1 henry, are connected in parallel, what is the total inductance?
8. For what percentage of each input cycle does plate current flow in a class "B" amplifier?

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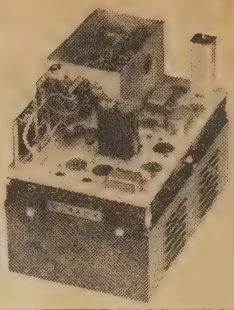

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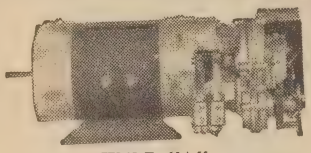

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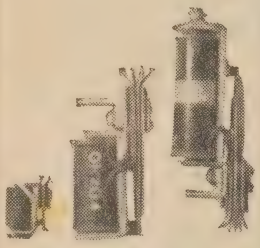
Postage and Packing—N.S.W. 7/6.
Interstate 12/6.

TYPE "B"

These motors are rated at 18 volts D.C. and develop 1/10th. H. P. but will operate on as low as 6 volts. Easily converted to operate on 240V A.C. as per R. & H. December, '49 or Hobbies Illustrated November, '50. Type "A" is fitted with gear box giving speeds of 4200—150—25—or 4 R.P.M. Type "B" is fitted with gear box giving speeds of 4200—20—or 5 R.P.M. and is also fitted with blower which has many uses. Both types have extended spindles.



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No. 1 Miniature relay 300 ohm coil, S.P.D.T.: contacts, 7/6

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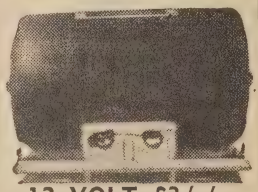
No. 3 Standard relay 15,000 ohm coil, 2 pole D.T. .. 12/6

All relays suitable for rewinding.

DEPENDABLE GENEMOTOR

H. T. SUPPLY FOR YODR CAR SET, AMPLIFIER, &c.



12 VOLT £3/-/-

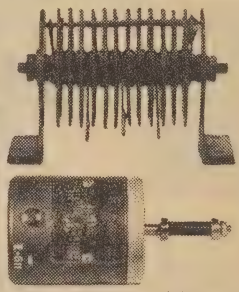
6 VOLT £3/10/-

Postage and Packing N.S.W. 6/-. Interstate 8/6.

AMERICAN GENEMOTORS

TYPE "A" Input 12V at 4 amp. Output 225 volts at 120 ma. TYPE "B" Input 6V at 6 amp. Output 200 volts at 60 ma. Size 7" x 4". Weight 7lb.

Input filter supplied free with each genemotor.



Small 24V Motor with Rectifier for A.C. Operation

The ideal small motor, with ball-bearing armature, measuring 3" x 2½". Input 24V D.C. or 30V A.C. using rectifier supplied 1500 R.P.M. Suitable for continuous operation.

MOTOR AND RECTIFIER

£2/-/-

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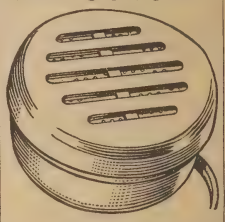
EXTENSION-UNIT



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Install it anywhere, in the sickroom, workshop, garage or any room in the house. Just connect across voice coil of the existing speaker.

THE "PILLO-FONE" IS THE MOST CONVENIENT LITTLE UNIT YET DEVISED.

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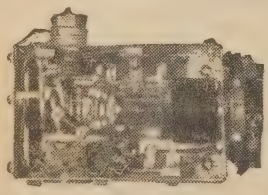

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Complete with 7193 valve, ready to use. Tuned by a split stator condenser worth this amount alone. An excellent driver for your 144 m/c. Transmitter. Alternatively modulate the unit as it stands.

TYPE "A"— 15/-

POST FREE

Frequency approx. 200 m/c. Adaptable to the 144 m/c Bend. Complete with 2-7193 Valves.

TYPE "B" 12/6

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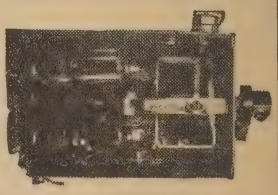

METROPOLITAN RADIO SUPPLIES

479 PARRAMATTA RD., LEICHHARDT. PHONE LM3610.

AT TOP OF TAVERNER'S HILL

A Course in Television

(Continued from Page 73)

...iter grid and why an FM receiver this general type has a threshold ...ow which AM noise can become a ...blem.

The time constant of the grid re...n resistor and bypass has an im...rtant bearing on the precise action the limiter. A long time constant desirable in the interests of supply... a well regulated signal to the ...de discriminator, but, unfortun...ely, it does not function as effec...ely as it might in limiting noise e to auto ignition and static ...shes.

DUCES NOISE

On the other hand, a short time nstant shows a much improved ise reducing characteristic, but orer regulation.

When only a single limiter stage used it is thus necessary and usual choose a compromise set of con...nts, opinions varying as to which mpromise is best.

More expensive receivers, on the ner hand, are often fitted with two niters, the first having a short ne constant and the second a much nger one, so that the discriminator provided with a well regulated gnal substantially free from ampli...de variation.

It will be apparent from the oper...ing conditions that a limiter stage ill not give anything like the gain at the same valve would provide operated under normal conditions.

Not only is its trans-conductance uch reduced by the low plate and reen voltage, but plate current ex...rsions are limited anyway as an sential part of its operation.

This would be a potent argument favor of the ratio detector were not for the fact that the ratio tector delivers considerably less udio for a given RF input than the ster-Seeley circuit. In the aggre...te the overall gain for a given mber of valves is not very differ...nt—the additional resolution of the ster-Seeley discriminator making p in part for the loss of gain in the miter stage.

THER DETECTORS

Other forms of FM detector have en evolved, the most notable xample in recent years being the -called phase detector.

A detector tube designed for this pplication (for evample the Philips Q80) has inner and outer control ids which are separated and ielded by five other grids. Sig...als from a type of discriminator ansformer are fed to the separate ontrol grids, which cause the plate urrent to vary according to whether he signal phases happen to add or ancel.

The signal output from this tube sufficient to drive a sensitive out...ut valve without additonal ampli...cation.

It is possible to use multi-grid ibes like the 6BE6 converter valve the same type of circuit, although esults are seldom as good as from he specially-designed valve.

GLARE-PROOF WINDSCREENS FOR NEW CARS

MOTORISTS will benefit by a new windshield glass that reduces road glare and heat. It is a glass of excellent optical qualities which is tinted a slight bluish-green in color and has a graduated shading above the eye level.

This tinted safety plate glass is a product of an American company and has already been thoroughly road tested in many parts of the United States. It passes the light-transmission requirements of the American Standards Association with a good margin to spare, according to an official of the glass company.

The bluish-green tint in the glass itself is obtained by mixing iron oxides in the glass during manufacture. By balancing the ingredients properly, it was found possible to eliminate about one-third of the sun's glare-producing rays and one-half the heat rays and still preserve the optical qualities of the glass.

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Voltmeter, type 1, 0-20 volts. Our Price 19/6.
0-40 volts. Our Price 19/6.
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Type Rola, midget. Prim. 7000 ohms, sec. 3.7 ohms. Our Price 4/6
Type Jensen, primary 7000 ohms, sec. 8 ohms. Price 4/6
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OFF THE RECORD — NEWS & REVIEWS

At last we have seen reasonable stocks of LP records in the various music houses in Australia due to the first shipments of Decca discs from England. Although they haven't been as large as many would have liked, at least they are beginning to come through.

By JOHN MOYLE

A CHECK made on the larger Sydney stores indicates that the demand is as great as ever. Any doubts which may have been held about the possible market have now been quite dispelled.

But the sales so far have been a mere flea-bite compared with what we might expect in the future.

Probably the largest percentage of the records have gone to people who have made or acquired special facilities for playing the records, either because they have been able to fit their own playing motors and pickups or because they have invested in the "playing desks" — motors and pickups — to use with their present radiograms.

It is certain that most of these people are not using really wide range equipment, but almost without exception they have all reported their delight with the results. This seems to answer one of the questions often posed—"will LP records be much use to the average man who hasn't lots of money to spend on equipment?"

The point I make is that these records have one thing which everyone can appreciate, and which is so important that it sets everything else back in the shade. This is the freedom which it gives from the now unbearable nuisance of constant record changing.

I have always maintained this to be of paramount importance. That's not to be wondered at because my introduction to the first LP records was at a time when my own playing facilities were temporarily no better than the average radiogram. It took me quite a while to get used to sitting still until the performance or the movement was over. At every likely pause in the music, particularly if it happened at a spot where I had been used to turning over with 78 versions, I'd be half out of the chair before I remembered, to sink back again with a sigh of relief and a murmured blessing on the head of Columbia!

The reduced surface noise of course was apparent in no uncertain manner, but it was the relaxation which came of the knowledge that I needn't get up for 20 minutes or so which hit me hardest.

Frankly, it wasn't until I heard the first of the English Deccas, and then the best of the American recordings, that the full force of the clean, wide-range impressed me fully. I'm afraid to appreciate this angle of the matter it is essential to have good equipment. But LP records have big things to offer anyone who uses them, and few still still imagine that only the fortunate few can realise them.

CHANGE IN OUTLOOK

This change in outlook has been somewhat amusingly reflected in various articles which have appeared from time to time in newspapers. After the writers—bless their hearts for I mean them no ill will—had managed to get the technical points clear in their minds about speed, stylus points, and the like (to say nothing of the terminology!) their remarks progressed from nice, safe fence-sitting, through sudden bursts of cautious enthusiasm to down-right unreserved praise. And now, having being presented with clear evidence that the LP record wasn't just a crazy idea or a flash in the pan, they are beginning to let their hair down and talk about the wonderful new future which lies ahead.

The fact now is that the 78 record is well on the down grade to an exit overseas. Many people who admitted that the LP record some day might command a market sufficient to cut into 78 sales have now agreed that what looked like a 10 year process is almost complete within three or four. I am referring here mainly to recordings of the longer works although in America reports indicate that 12 inch 78 records on the old shellac base are no longer produced.

In USA, of course, the small 45 rpm record also commands a big sale, and looks as though it will play possibly a major part in the

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recording of single items. But it is not an LP record, and there is the rub.

Not long ago we reprinted an article from Wireless World written by an engineer of EMI which showed that, up to possibly 20 minutes of recording time, it was possible to make good 45 rpm 12in records. Frankly, I cannot now see any point in making the attempt, nor any great virtue in pushing the case for a single speed.

I hold this view because of the success which has met efforts to make reasonably cheap, dual and three-speed motors. These can be bought in large numbers with a knob which selects any of the three speeds in a second, and apparently without any worries. It is certain that high quality motors, costing a little more, could and will be made to perform the same function.

NO NEED FOR 78

There is, therefore, no need now to continue making 78 records. The 45 type are very much better for short numbers, and the 33 LP types have proved perfectly satisfactory for up to almost 30 minutes continuous music.

There is still the section—in Australia quite a large one—with only 78 rpm playing facilities. But like old-type motor cars and the like, many of these are due for replacement. The majority use heavy pick-ups which are poor things even with 78 records. By using a crystal pick-up and multi-speed motor nearly all of them could make the change without too much trouble. There is no need to discard one's 78 library. Many of the discs are still valuable—certainly they'll sound better with a good pick-up than they did with the old. I'm convinced that scrapping the 78 record as quickly and as painlessly as possible would be a good thing. In America, recording companies cut their losses by selling out sets of 78 records at 50 pc off list.

In England and Australia, the American position hasn't been reached, but sooner or later it will. There's no news yet from EMI as to their plans, but I wouldn't be surprised to see them make a bold move when it does come, possibly issuing LP records and 45 records under all labels. They have both Columbia and HMV (Victor) names, original exponents of the 33 and 45 records. However, things have reached the stage now where all companies will probably end up by accepting both speeds.

NEW RADIOGRAMS

It's certain that all new radiogram models will be issued with LP facilities, and those factories which haven't completed their designs are hard at work finishing them off. Some of them are still persevering with record changers, but I feel that much of the case for these mechanical marvels has disappeared.

I suppose there will still be people who want to pile up a random collection of short numbers to be played automatically, which was the original idea behind 45 records. Be that as it may, there is now no problem concerning speeds important enough to hold up acceptance of the new standards, except the inevitable business worries of the recording companies themselves. There's little doubt that these will not hold up the works for ever.

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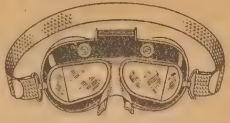

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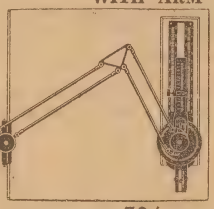

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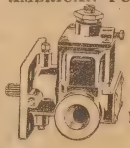

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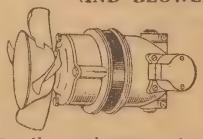

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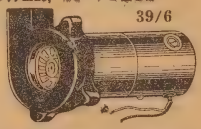

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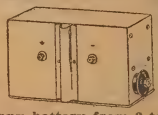

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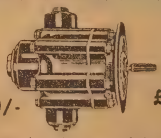

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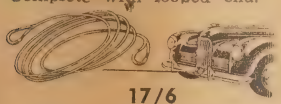

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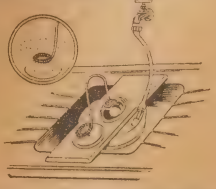

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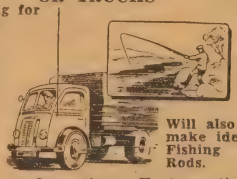

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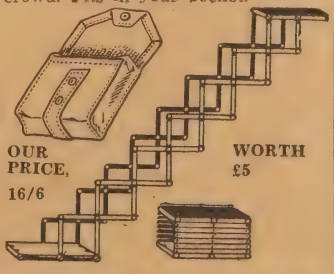

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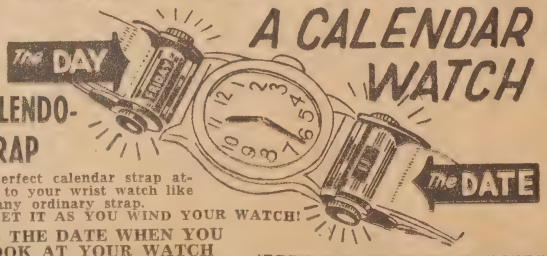

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ENLARGERS AND ENLARGING

(Continued from Page 89)

the amount of work which the unit is likely to handle. A particular design may be quite satisfactory for many years if used only in an amateur capacity, but would be quite unsuitable for continuous work in a commercial darkroom.

Poorly designed focusing mechanisms will also cause the lens to deviate from a plane parallel to the negative plane as adjustments are made, and will throw one or both sides of the image out of focus relative to the centre or the opposite side. This is a fault which should not be tolerated in any instrument, for it renders accurate focusing almost impossible.

AUTOMATIC TYPE

Another focusing system is the automatic type with which it is only necessary to raise or lower the head to give the required size image, the focus remaining correct at all times. This is achieved in a number of ways, the most popular method being the use of a specially tapered "blade" mounted on the supporting column. The varying width of the blade is used to actuate a lever system coupled to the focusing mechanism and so set the lens correctly according to the position of the head relative to the base board.

This type is not so popular at the present time, mainly due to the high price, but, in any case, a certain amount of doubt sometimes accompanies their use, the operator having the feeling that perhaps the best possible focus has not been achieved, simply because he has not been able to check it himself. Whether this doubt is justified or not depends to a large extent on the quality of the instrument, but the arrangement is seldom as satisfying as a well-designed manual system.

Except in the case of exhibition prints which are to be mounted the usual finish is a white border about ½in wide and this is achieved by means of an adjustable masking board. These will usually accommodate up to 10in x 12in, although larger ones are available if required. In any case they should be fitted with easy to read markings in inches and fractions of an inch to permit quick setting for a particular size of paper.

To facilitate such setting up, when required, many enlargers have an orange filter which can be moved in front of the lens. This enables the image to be projected on to the sensitive paper without affecting it, thus allowing it to be placed in the correct position. This device is also extremely valuable for special effects, such as multiple printing, etc.

In addition to the various features which can be regarded as desirable, it is essential that the general standard of workmanship be of a high order if the unit is to give satisfactory service. Flimsy construction, lack of rigidity, adjustments that jam or bind—all should be avoided like the plague, for they are both time-wasting and detrimental to good results.

Keeping all these points in mind you should be in a better position to select a model suited to your needs, and once you have it you will realise what a vast field of new possibilities it opens up for you.

ANSWERS TO CORRESPONDENTS

A.B. (Corio, Victoria) sends a technical uery and also inquires about a back umber and the charges for classified dvertisements.

A.: The value of the two resistors is ot particularly critical as they are only equired to provide a centre tap to the lament winding. If they are too low hey will impose too great a load on ransformer winding and if too high will ause undesirable drop in the output oltage. Either of the values shown will ive equally good results with the trans-ormer specified. We are forwarding you he back copy you require by post. Pre-ent rates for classified advertisements s 2/- per line (average six words per ine).

R.S.W. (Glossop, SA) advises of a change f address, forwards a subscription, and nakes some very nice remarks about he "Answer Tom" section.

A.: Your change of address and sub-cription have been passed on to the ppropriate department, R.S.W., and many hanks for your remarks about the "Tom" age. We do endeavor to present what night otherwise be dry subjects in a nanner which makes them more palat-ble and thus more easily understood. We can assure you that most of the umor comes quite spontaneously, al-hough occasionally other members of he staff may contribute. The increased ate does not apply to current subscrip-ions and the 2/6 has been added on to our account.

F.W.W. (Cheltenham, Vic.) wants a cir-uit of an amplifier suitable for record-ng and suggests that we may have some-hing with push-pull triode output valves.

A.: We have several recording ampli-ier circuits on our files but these use ingle-ended outputs. However, we feel ure that you would find them quite uitable for your requirements and quite qual to the quality of the average ecording gear. We know of no com-nercial tuner of the type you mention, lthough there are several such designs vailable from our files. The Radio and Hobbies "Junior Recorder" (April, 1951) ncorporates such a tuner.

H.R.T. (Mareeba) writes in appreciation of Radio and Hobbies and suggests a couple of popular science subjects on which he would appreciate information.

A.: Many thanks for your remarks and suggestions. We have passed your letter on to Calvin Walters, who usually contributes the articles of this type. He may be able to oblige within the next couple of months.

R.J. McC. (Surry Hills, Victoria) wants to know if there are available any simplified circuits of the Current playmaster series as he does not feel competent to tackle the job from the published data.

A.: Sorry R. J. McC. but this is one of the things we cannot undertake. The series was not intended for the absolute beginner and we are afraid it is simply a case of learning to crawl before you can walk. Had we gone to the trouble to prepare any additional drawings, however, they most certainly would have been published. It is quite impossible to prepare drawings specially for individual readers. This is not a matter of cost, but simply that we just do not have the time. The better quality speakers referred to would approach the price you quote and something along these lines is really essential if the quality of the amplifier is to be realised.

N.A.H. (Windsor NSW) is having difficulty with a 5" CRO he has just completed.

A.: Considering all the steps you have taken so far it is rather difficult for us at a distance to indicate what the trouble might be. We would suspect coupling through the B-plus line and suggest you try extra filtering or decoupling, particularly of the time base. The fact that an elipse is formed indicates that the two deflection frequencies are the same. Check also for capacitive coupling between the wiring of the two amplifiers and the time base. Coupling of the time base circuit into the C.R. tube grid or cathode would cause the interference to modulate the intensity of the beam rather than to deflect it.

E.S. (Sofala NSW) is anxious to obtain some information on 1000 watt RAAF generators available through disposals.

A.: We cannot help you, E.S., but some reader who has had experience with these units may be able to do so. Here's hoping. (Mr. E. Sant, Sofala 3W, NSW).

R.M. (East Brighton, Vic.) says he has applied some of the amplifier hints and methods featured recently in "Radio and Hobbies," apparently to good purpose.

A.: Many thanks for your further letter and we are glad to note that we have been able to assist you. It is particularly important to have a solid lid over the pickup to render it completely silent with the amplifier turned off. Many readers miss this point and mistake the acoustic chatter from the needle for amplifier distortion. We will run some tests on the pickups you mention at the first opportunity.

NEW ARRANGEMENTS FOR OUR QUERY SERVICE

RISING costs and increasing correspondence have made it necessary to revise the conditions governing our postal query service.

In future, all queries concerning "R & H" designs, to which a POSTAL REPLY is required, must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three "R & H" constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis will now be 3/6. These are available for nearly all our designs.

Address your letters to The Technical Editor, "RADIO and HOBBIES," Box 2728C, GPO., Sydney.

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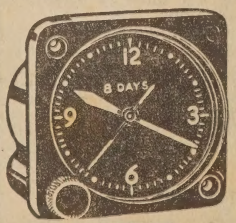

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A READER BUILT IT!

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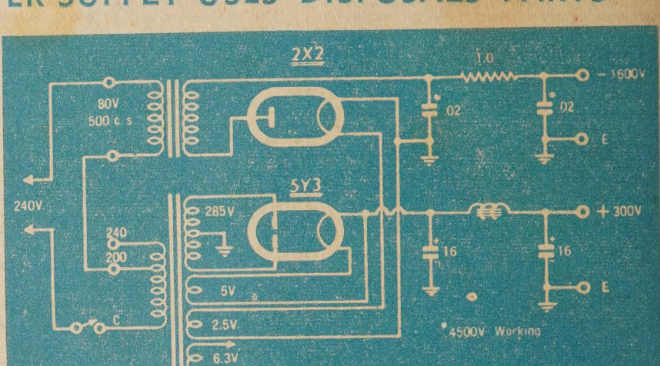
NOVEL CRO POWER SUPPLY USES DISPOSALS PARTS

Due to the cost of high voltage transformers, power supplies for cathode ray oscilloscopes are very expensive to construct. However, a reader, Mr. L. Mladejovsky, of Bendigo, Victoria, sends in the circuit of high tension supply using a transformer which can be obtained from disposals stores for a few shillings.



The above circuit is an exact reproduction of that sent in by our correspondent. Readers should have no difficulty in adapting it to suit their own particular purpose. Alternative valves are discussed in the text but there are so many different types of 500 cycle transformers in existence that is is impossible to list them.

TRANSFORMERS able to deliver a sufficiently high voltage to operate cathode ray tubes are expensive because, in order to provide the high voltage, it is necessary to wind a large number of turns of fine wire for the secondary, and to prevent breakdowns within the transformer special insulation must be provided. Finally, the transformer has to be subjected to a stringent breakdown test.

Some excellent transformers specially insulated and tropic proofed, but designed to operate from a 500 rather than a 50 cycle supply, have found their way through to radio stores from disposals sources and are available for a few shillings.

If these transformers are connected to the 50 cycle supply at their marked voltage they will overheat, but if the applied voltage is reduced to something less than the 500 cycle rating they are capable of giving excellent service at 50 cycles.

PARTICULAR CASE

The transformer used by Mr. Mladejovsky is rated at 80V 500 cycles and has a 3450V secondary. He overcame the difficulty of supplying the primary by connecting it in series with the 200V primary of the ordinary 50 cycle receiver transformer used to supply the amplifiers, &c., of the oscilloscope.

The voltage distribution between the two primaries depends on several factors, but, since most of the primary winding of the receiver transformer is in circuit, there is no danger of drawing excessive current from the power mains. The idea is to use whichever of the primary taps delivers the correct secondary voltage.

To avoid any possibility of damage, a good idea would be to start with the 240V tap and work down toward the 200V tap, measuring the secondary voltages after each adjustment. Of course, this should be done when the normal load is being drawn from the high voltage section of the supply, otherwise the voltage across the receiver transformer will be less than normal.

The ratio of primary to secondary voltages depends on the turns ratio of the transformer and will therefore be the same as with the 500 cycle supply.

If the circuit happened to work out as shown above, 40 volts would appear across the primary of the high tension transformer and the voltage appearing across the secondary would be 1725 less a small amount, as the voltage drop within the winding will depend on the current being drawn. The voltage drop should not be very great, however, as the current required by CR tubes is usually only a few milliamps.

If the voltage output of the supply is too high, it is a simple matter to insert a dropping resistor in series with the high tension lead. In most cases this resistor need only have a power dissipation of 1 or 2 watts. Apparently the current required by our contributor is very low, since he has used a 1.0 meg dropping resistor

DROPPING RESISTOR

Incidentally, where it is necessary to have a high voltage appearing across a high resistance it is better to use two resistors of lower value in series, than one resistor of high value. In this case you could use two 0.5 meg resistors in series.

For the high voltage rectifier you could use an AV11 instead of the 2X2 suggested, although the AV11 is somewhat larger physically than the 2X2.

Practically any one of the standard rectifiers could be used in place the 5Y3 suggested for the 300V pow supply. Since the current drain w normally be quite low, the intern impedance is not as important as would be in the case of a receiv or amplifier drawing considerab current. A 6X5 would also be sui able, provided the filament volta is adjusted to suit.

Also, because the current drain low, the resistance of the filter choh for the 300 volt supply is not of par mount importance. The prima winding of an old speaker transfo mer could be made to serve the pu pose admirably.

MATHEMATICAL APPROACH

While on the subject of 500 cyc transformers, we have received interesting letter from Mr. N. Henderson, of Yallourn, Victoria, wh gives a mathematical basis for a riving at the ratings of these tran formers when operated with a cycle supply.

The substance of Mr. Henderson letter is that it can be shown th applied voltage should be reduced a quarter or less of the 500 cyc rating. However, due to the less "skin effect," the current drawn fro the windings may be increased about 12½ pc on the 50 cycle suppl

Our own experience has been th most of these transformers are qui safe with about 1/3rd of their 5 cycle voltage rating. This does n dispute our correspondent's findin but suggests that the transforme were fairly conservatively rated f their 500 cycle service.

Points on Tape Recording

(Continued from Page 74)

coupled with the non-linear amplitude effect, makes very long wavelengths unimportant in transfer.

High frequencies are weakly transferred because the non-magnetic backing layer of the tape causes a much higher attenuation of the fields of very short wavelengths than of longer wavelengths.

Some decrease in transfer can be effected by the use of thicker backing material, but the difference is mainly in the higher frequencies.

It should be emphasised that the problem of transfer is not bothersome to an average user. The effects discussed are generally well below the noise level of the tape, and special efforts are necessary to detect and measure them.

The existence of transfer at an annoying level is fair evidence of neglect of one or more of the above principles. This follows from our quantitative tests and also from the fact that extremely few users have ever detected the phenomenon. Noticeable signal transfer is not a necessary evil of tape recording, but merely a possible hazard.

To summarise, we may avoid noticeable layer-to-layer transfer of signals in rolls of recording tape by:—

(1) Recording below the overload point of the tape.
(2) Avoiding exposure of recorded rolls to magnetic fields.
(3) Avoiding storage of reels in hot places.

HOW TIME EFFECTS ERASURE

It is well known that the difficulty of erasing a magnetic recording is a function of the magnetic material used, depending upon the coercive force, and more particularly the saturating field for the medium.

It has also been observed that high frequencies are more easily erased than low frequencies. This is probably an effect of the geometry of the field at an erase head, since the field is strongest at the surface of the tape and the front surface magnetisation is predominant in high frequency signals.

It has also been shown that the difficulty of erasure is affected by the bias current used in recording.

However, it has apparently been tacitly assumed that there are no time dependent factors in the difficulty of erasure. This is a plausible assumption, since recorded signal levels and the magnetic properties of the tape do not change measurably with storage. Nevertheless we have found that it is not true.

Generally, a recorded signal becomes harder to erase after storage.

A loud note, which can be easily erased immediately after recording, may become so much harder to erase after months of storage that two or three times as much erase current is required to obliterate it. In extreme cases it has been found that an ordinary erase head could not be excited sufficiently to get rid of the signal altogether.

In such cases an "external" erasure by a strong electromagnet (for example, the Goodell "Noise-eraser") completely eliminates the signal, but it may return during biasing or other excitation during a subsequent recording.

This effect is not serious except for high-quality recordings because the effect is very small.

For example, after storage, an erase head may reduce a loud signal by perhaps 55 db, after which external erasure reduces it to a level at least 80 db below its original level. The signal may then be "revived" to a level of perhaps 60 db below the original level, which may leave it audible even if below the noise level.

This would be a very severe case, with much less effect being observed in most instances. Such performance has never been described in the literature and there is no adequate theoretical explanation available.

Heat has the effect of speeding and accentuating this increase in permanency, so that a roll stored a few hours at 80deg. C shows the same effects as a roll stored months at room temperature.

A recording which has aged and become semi-permanent may, however, be removed by demagnetisation and storage in the demagnetised state.

Elevated temperature of storage in the demagnetised condition accelerates the obliteration of the magnetic "memory."

While the fundamental reasons for this behavior need not be discussed here, it is worth noting that not all magnetic materials show the same effect. In particular, "SCOTCH" Sound Recording Tape No. 111 and film No. 115, No. 116 and No. 117 show the effect negligibly or not at all. This valuable property of these tapes thus makes them especially desirable for recordings which must be kept for long periods of time before re-use.

In the case of recordings already made and particularly those made on tapes of other magnetic materials, the following procedures may be of practical importance:

1. Store tapes in erased rather than recorded condition when the recording is no longer needed.

2. A tape having a background signal which cannot be completely erased should be stored for a few days in the erased condition, preferably not in a cool place.

3. Store recorded rolls in a cool location (this is also advisable for long tape life and freedom from layer-to-layer signal transfer).

4. Switch to "SCOTCH" Sound Recording Tape No. 111, No. 115, No. 116, or No. 117.

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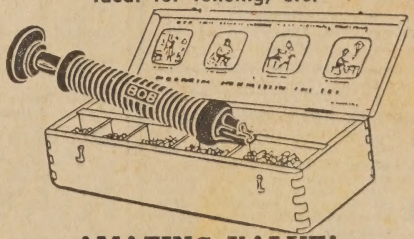

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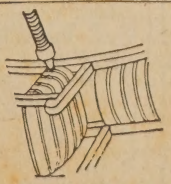

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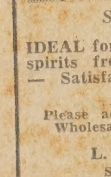

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